University Of Alberta

AN INVESTIGATION OF THE LEARNING STYLES OF UNDERGRADUATE PHYSICAL THERAPY STUDENTS AND PRACTICING PHYSICAL THERAPISTS

by

GORDON ALEXANDER (SANDY) RENNIE ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial
fulfillment of the requirements for the degree of Doctor of Philosophy
in
Educational Administration and Leadership

DEPARTMENT OF EDUCATIONAL POLICY STUDIES

Edmonton, Alberta

Fall 2002

National Library
of Canada

Acquisitions and
Bibliographic Services

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale
du Canada

Acquisitions et
services bibliographiques

395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-81256-1

Canada

University of Alberta

Library Release Form

Name of Author:	Gordon Alexander (Sandy) Rennie
Title of Thesis:	An Investigation of the Learning Styles of Undergraduate Physical Therapy Students and Practicing Physical Therapists
Degree:	Doctor of Philosophy
Year this Degree Granted:	2002

Permission is hereby granted to the University of Alberta Library to reproduce single copies of this thesis and to lend or sell such copies for private, scholarly or scientific research purposes only.

The author reserves all other publication and other rights in association with the copyright in the thesis, and except as herein provided, neither the thesis nor any substantial portion thereof may be printed or otherwise reproduced in any material form whatever without the author's prior written permission.

2717 - 118 Street
Edmonton, Alberta
Canada T6J 3P8

Date: September 3/02

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **An Investigation of the Learning Styles of Undergraduate Physical Therapy Students and Practicing Physical Therapists** submitted by Gordon Alexander (Sandy) Rennie in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Educational Administration and Leadership.

Donald M. Richards
Dr. Donald Richards, Examination Committee Chair
Educational Policy Studies

D Collett
Dr. David Collett, Supervisor
Educational Policy Studies

Paula A. Brook
Dr. Paula Brook
Educational Policy Studies

Dr. Michael Andrews
Educational Policy Studies

Paul Hagler
Dr. Paul Hagler
Faculty of Rehabilitation Medicine

Dr. Beverly Cameron
University of Manitoba

Date: August 30/02

DEDICATION

This thesis is dedicated to the loving memory of my mother Ivy, who passed away in April 2002, and was unable to witness completion of my PhD. My mother was always a strong supporter throughout my professional and academic career. She always told me how proud she was of my achievements. However it was I who drew strength and inspiration from her indomitable spirit and courageous disposition. She fought the ravages of osteoporosis and emphysema yet always had a loving smile and a kind word for her family. This is for you, Mom.

ABSTRACT

The learning style preferences of 220 University of Alberta undergraduate physical therapy students and 81 practicing physical therapists (former U of A students) were examined over a three year period using the Kolb Learning Style Inventory. The results indicated that the majority of the students and practicing therapists were Convergers and Assimilators. Both these types of learners rely on the abstract mode of learning, where they think about something before actually trying it. Convergers prefer to do an activity while they are learning it, while Assimilators prefer to watch others perform the activity before attempting it themselves.

There were no significant differences in learning styles across the four years of physical therapy students, nor between two groups of practicing physical therapists, which is consistent with published literature. There were also no differences in learning styles between the students and the practicing therapists. This result was a little unexpected as I thought the learning styles of the therapists might differ as they were no longer in "student mode". However learning style preference did not change from student to graduate. The learning styles of neither the students nor the practicing therapists changed over time, which is also consistent with current literature.

With regard to gender, the only significant difference determined was that male practicing physical therapists were primarily Convergers. However the number of males in that group was small.

The results of this study indicate that students who get admitted into the

physical therapy program at the University of Alberta will learn the necessary material no matter what their preferred learning style. They need a body of knowledge in order to graduate and begin their clinical practice. They gain this knowledge at a very high level (these students are high achievers) and carry this with them after graduation. While it appears Convergers and Assimilators are attracted to physical therapy, all students in the program do well in a variety of teaching and learning situations. Instructors should be encouraged to use a variety of teaching strategies focussing on the affective domain and student centred learning in order to cater to all learning styles.

ACKNOWLEDGEMENTS

Many people have helped me along this journey. To all of them, I owe a huge debt of gratitude. In particular, I want to thank the following people:

Dr. Paula Brook, for convincing me that pursuing a PhD was worthwhile.

Dr. Jean Wessel, for allowing me to participate in the original learning styles study, and for providing assistance early in my project.

Dr. Paul Hagler, for answering my many questions related to methodology and statistics.

Dr. Ted Holdaway, who always reassured me things would work out, even when I felt differently.

Dr. Dave Collett, my Supervisor, who has stuck with me through thick and thin and never gave up hope that I would complete this project.

My thesis committee, for their guidance, support and encouragement.

My students, both past and present, for being involved in my research, and for providing me with the opportunity to participate in their learning.

Dr. Jim Vargo, a mentor, advisor, confidante and wonderful friend, who has given me more help, support and guidance than one should ever expect to receive. Without his assistance, this thesis would not have reached completion.

My family, both immediate and extended, for their continued support and encouragement.

My father, who, throughout my academic and professional career, has maintained steadfast in his love and support.

And finally, my wife and best friend Jo, for her unwavering support, unfailing encouragement, and unconditional love when I needed it the most. She is the reason, above all others, why I was able to complete this PhD.

TABLE OF CONTENTS Page

Chapter 1 INTRODUCTION 1
Background 1
Rationale for the study 4
Objectives of the study 8

Chapter 2 REVIEW OF THE LITERATURE 12
Teaching methods and strategies 12
Student centred learning 13
Problem-based learning 13
Inquiry-based learning 14
Effects of student centred learning 15
Learning styles 20
Cognitive style 21
Kolb's Learning Theory 23
Learning styles of physical therapy students 28
Learning style preference and gender 35
Contributions of learning theory to practice 37
Summary 42

Chapter 3 METHODOLOGY 43
Study design 44
Ethical considerations 45
Research questions 45
Data collection timetable and procedures 46
Dependent and independent variables 49
Delimitations 49
Limitations 50
The instrument: Kolb's Learning Style Inventory 51
Kolb LSI scoring 54

Learning modes 56
Learning style 59
Reliability and validity of the Kolb LSI 63
Ipsative characteristics of the Kolb LSI 64
Data analysis 66
Summary 69

Chapter 4 RESULTS 70
Demographics 70
Data sets 72
Research questions 75
    Research question 1 75
    Research question 2 84
    Research question 3 89
    Research question 4 92
    Research question 5 96
    Research question 6 98
    Research question 7 100
Summary 103

Chapter 5 DISCUSSION, CONCLUSIONS AND IMPLICATIONS

Summary of the study 105
Discussion 108
    Learning style characteristics 108
    Combined scores 112
    Learning style preference of physical therapy students 114
    Learning style preference of practicing physical therapists 120
    Learning style preference over time 123
    Learning style preference and gender. 124
Teaching and learning 125
Conclusions 136

Implications 136
Recommendations for further research 137
Personal reflections and final thoughts 138

REFERENCES 142

APPENDICES 156

LIST OF TABLES

Page

Table 2.1 Learning style measurement tools in physical therapy 29

Table 3.1 Data collection timetable for all groups 47

Table 4.1 Demographic data of all groups 71

Table 4.2 Comparison of Kolb LSI means and standard deviations of AC, AE, CE and RO scores of physical therapy students at time 2 . . . 76

Table 4.3 Scheffé post hoc analysis of mean AC, AE, CE and RO scores of all physical therapy students 78

Table 4.4 Kolb LSI combined AC-CE and AE-RO score means and standard deviations taken at time 2 for all physical therapy students 79

Table 4.5 Learning style preferences of physical therapy students 81

Table 4.6 Scheffé post hoc analysis of learning styles of physical therapy students 83

Table 4.7 Comparison of Kolb LSI means and standard deviations of AC, AE, CE and RO scores of practicing physical therapists at time 2 85

Table 4.8 Kolb LSI combined AC-CE and AE-RO score means and standard deviations taken at time 2 of all practicing physical therapists 86

Table 4.9 Learning style preferences of practicing physical therapists 87

Table 4.10 Scheffé post hoc analysis of learning styles of all practicing physical therapists 88

Table 4.11 Observed frequencies of learning style preference of physical therapy students at time 1 and time 2 95

Table 4.12 Observed frequencies of learning style preference of Group E at Time 1 and Time 2 98

Table 4.13 Observed frequencies of learning style preference of female and male physical therapy students 100

Table 4.14 Observed frequencies of learning style preferences of female and male practicing physical therapists 103

Table 5.1 Learning strengths and preferred learning situations for each of Kolb's learning style characteristics 131

LIST OF FIGURES

Page

Figure 2.1. Kolb's Four-Stage Learning Cycle 25

Figure 2.2 Kolb's Learning Styles 26

Figure 2.3. Learning styles and the problem-solving process 41

Figure 3.1. Kolb's Learning Style Inventory: Instructions for use 53

Figure 3.2. Kolb's Cycle of Learning 55

Figure 3.3. Kolb Cycle of Learning Example 1 57

Figure 3.4. Kolb Cycle of Learning Example 2 58

Figure 3.5. Kolb Learning Style Type Grid Example 1 61

Figure 3.6. Kolb Learning Style Type Grid Example 2 62

Figure 4.1. Means and standard deviations of AC, AE, CE and RO scores of physical therapy students 77

Figure 4.2. Means and standard deviations of AC-CE and AE-RO scores for all physical therapy students (Groups A-D) 80

Figure 4.3. Number of physical therapy students in each of the four Kolb learning style categories 82

Figure 4.4 Means and standard deviations of AC, AE, CE and RO scores of practicing physical therapists (Groups E & F) 85

Figure 4.5 Means and standard deviations of AC-CE and AE-RO scores for all practicing physical therapists (Groups E & F) 86

Figure 4.6 Number of practicing physical therapists (Groups E & F) in each of the four Kolb learning style categories......................... 87

Figure 4.7 Comparison of means and standard deviations of AC, AE, CE and RO scores of all physical therapy students and all practicing physical therapists 90

Figure 4.8 Comparison of means and standard deviations of combined AC-CE and AE-RO scores of physical therapy students and practicing physical therapists 91

Figure 4.9 Means and standard deviations of repeat ANOVA of AC scores of all physical therapy students (Groups A-D) 93

Figure 4.10 Means and standard deviations of repeat ANOVA combined AC-CE scores of all physical therapy students (Groups A-D) . . . 94

Figure 4.11 Means and standard deviations of repeat ANOVA combined AE-RO scores of all physical therapy students (Groups A-D) . . . 94

Figure 4.12 Means and standard deviations of AC-CE scores of Groups E taken at Time 1 and Time 2 97

Figure 4.13 Means and standard deviations of Abstract Conceptualization (AC) scores of female and male physical therapy students 99

Figure 5.1 Instructional activities that may support different aspects of the learning cycle 132

Chapter 1

INTRODUCTION

"Personally, I am always ready to learn,
although I do not always like being taught."
Sir Winston Churchill

Background

Health care restructuring in recent years has presented new challenges to physical therapy education and physical therapy practice in Canada. The newly graduated physical therapist must be a self-reliant professional who can collaborate with professionals from other disciplines while serving multiple functions of patient care, research, education, and supervision of students and support personnel. The Physiotherapy Vision Report (Alliance, 1993) predicted that the roles of physical therapists as consultants, educators, and agents of change in the health care delivery system will increase. In addition, more provinces are allowing direct access to physical therapists rather than through medical referral, which requires physical therapists to be more independent. The Canadian Council of Directors of Physiotherapy Academic Programs (CDPAP) responded to the Vision Report concluding that educational programs must produce graduates who: (a) are willing and able to accept responsibility for lifelong learning and professional development, (b) work in a practice that is evidence-based, (c) evaluate the effectiveness of their interventions, and (d) are accountable for their practice (CDPAP/CPA, 1995). In some quarters, increased pressure is being placed on physical therapy education programs to graduate clinicians who are “prepared to adapt to the evolving nature of physical therapy practice” (Graham, 1996, p. 857). With this in mind, educational programs may need to re-examine their curricula, and, where necessary, make changes in preparation programming. Teaching and learning approaches must be examined, and possibly changed, to more effectively prepare students to meet these new and rapidly changing practice and professional demands.

The need for increased knowledge and physical therapy skills in concert with broader professional skills means that physical therapists must be able to learn how to learn. In the revised curriculum guide for Canadian physical therapy programs, a student-centered, problem-focused learning approach was suggested as a method needed to meet the requirements of the profession (CDPAP/CPA, 1995). While this approach may meet the expectations and needs of the educators, does it meet the needs and expectations of the students? While physical therapy students may not know what is appropriate for them to learn in terms of content (e.g., knowledge, skills, and attitudes), they may know how they best learn that content (e.g., learning styles and strategies). Indeed, the problem is not confined to Canada. In a recent article from Australia, Hunt, Adamson, Higgs, and Harris (1998) described the need for the profession and its educators to review current teaching in physiotherapy. They offered “curriculum and teaching strategies that could be implemented to foster the required skills and attributes in its newest graduates to ensure that they meet the needs of the community, thereby facilitating the ongoing development of the profession" (p. 264).

It is important, however, not only to examine the physical therapy curricula and the needs of the profession, but to examine the needs and objectives of physical therapy students. If, as Hunt et al. (1998) state: "...students need time to think, assimilate and reflect on all aspects of their learning, including the experiences which are not stated formally in the curriculum" (p. 268), are educators providing the time and resources necessary to achieve these expectations? What are the learning objectives of the students? Do educators ask the students what methods of teaching and learning work best for them? Solomon (1994) takes this question one step further by suggesting that a curriculum with a problem-based approach may also require different admission procedures from those in traditional programs. She suggests that "the qualities of the desired applicants often focus less on academic achievement and more on motivation, suitability for the programme, background experience, personal insight and knowledge of the profession" (p. 50). If there needs to be a shift from teaching content to teaching process, then it is important to determine if the applicants (or the students admitted to the program) can learn process as well as content. It may not be appropriate to ask students in a professional program what they prefer to learn because they may not be aware of the curriculum and the learning objectives. However, asking students how they prefer to learn is an important and relevant question. Research in the area of individual differences in cognitive and learning styles is based on the theory that these styles are relatively stable attributes, preferences, or habitual strategies used by each individual to organize and process information for problem solving.

Rationale for the study

> ***"Education is not the filling of a pail, but the lighting of a fire."***
>
> William Butler Yeats

The rationale for this study is established by the fact that there is not a great deal of information that examines the relationship between learning styles and teaching methods as encountered in professional education programs such as physical therapy. While physical therapy curricula in North America have changed over the past 40 years, the most significant changes have occurred over the past 20 years (CDPAP/CPA, 1995; Cleather, 1995; Graham, 1996). The most recent changes have been primarily in response to the needs of the profession and the requisite skills required by graduates as they enter clinical practice. In the 1970s, physical therapy programs began shifting to more competency-based curricula focusing on terminal competencies for entry-level performance and on criterion-referenced evaluation (Graham, 1996). Graham noted that "curricula in the late 1970s and early 1980s emphasized the development of problem-solving skills" and that "curricula based on a problem-based approach were organized around themes of physical therapy practice rather than around subject matter" (1996, p. 857). Hunt et al. (1998) suggested that the challenge for educators of future physical therapists is to find a balance between providing graduates with the necessary knowledge and skills for the workplace, and enabling them to make a contribution to the development of the profession. This can be achieved "through the graduates' own adaptation to changes and professional development, and through their research and scholarly input into the profession's knowledge base" (p. 264).

While there obviously has been considerable interest in curriculum development and delivery — particularly from the point of view of educators and clinicians — there appears to have been less interest in learning styles, especially from the point of view of the students. How does learning style relate to curriculum delivery or teaching method? Is there a relationship between the two? Can people learn more effectively if they are taught the same way they prefer to learn? Cross (1990) suggests that in order to improve teaching we need to pay attention to learning. Angelo (1994) contends that "most faculty development efforts focus primarily on improving teaching — and only secondarily, if at all, on improving learning" (p. 17). Knapper (1995) is more direct: "The bottom line is learning" (p. 70). Smith (1995) suggested that there are differences of opinion about what needs to be done — should faculty change their teaching methods or should students change their learning style? He explained: "In general, the culture of the academy doesn't seem to include much discussion of differences in learning styles, or of adapting teaching to individual differences" (p. 17). Smith described what is probably more truth than fiction, but only discussed behind closed faculty office doors: "Many faculty seem to be saying *'send me students who can learn from the way I know how to teach,'* rather than *'I need to learn how to teach to the students I am sent*" (p. 17).

Titchen and Coles (1991) compared students' approaches to studying in subject-centered and problem-based courses over two years and found that students at the subject-centered school were adopting more desirable study habits than the problem-based students. However that study did not measure actual learning style. Wessel, Loomis, Rennie, Brook, Hoddinott and Aherne (1999) determined that there was no change in student learning styles across second, third and fourth years of a physical therapy program. However that was a cross-sectional rather than a longitudinal study. Van Langenberghe (1988) also examined learning styles of physical therapy students across two years and found no significant differences.

Experiential learning is a four stage cycle that ends with application to real world situations (Kolb, 1984). This approach takes the learner through a sequence of learning stages in which each stage has specific objectives, and builds upon the knowledge, skills and abilities learned in the previous stage(s) (Sims & Sims, 1995). The idea is that the learning model for each new concept should follow a defined sequence: concrete experiences, followed by reflective experiences, moving to abstract experiences, and ending with active experimentation experiences. The final objective of the learning experience is the ability to apply the concepts to the real world experiences the student will face upon graduation (Sims & Sims, 1995). This type of learning model is what should be effective in a program such as physical therapy because of the very nature of the practice of physical therapy that involves the application of the concepts of a treatment plan to real patients and using objective measures to assess the outcomes.

The Physical Therapy (PT) program at the University of Alberta in Edmonton, Alberta, Canada, decided to adopt a more student centred approach to teaching and learning (Department of Physical Therapy Revised Curriculum Document, 1996, p. 7). The change in philosophy was reflected in a change in the department's approach to teaching and learning, in that is attempted to teach using methods and techniques that were designed to foster independent, critical thinking in the students. The teaching strategies included those that required the students to become more active participants in their learning. Three primary methods of achieving active student participation included problem-based learning, inquiry-based learning, and self-directed learning. In order to help determine if these teaching methods would meet the students' needs, it was worthwhile to examine the students' learning styles. By determining the student's preferred learning styles and examining teaching and learning strategies, the department could more closely examine if both the students' needs and the aims of the revised curriculum were being met.

Further justification for this study was the fact that, while there have been studies that have examined the learning styles of physical therapy students (Barb, Scudds & Scudds, 1997; Barris, Kielhofer & Bauer, 1985; Daniel, 1999; Farina, 1997; Gaden, 1992; Hick-Rheault, 1990; Katz & Heimann, 1991; Kolb, 1984; Olson, 2000; Payton, Hueter & McDonald, 1979; Pisarski, 1994; Rahr, 1988; Sandmire, Vroman & Sanders, 2000; Van Langenberghe, 1988; Vittetoe, 1983; Weber, Olson, Barber, Perry & Burgess, 1996; Wessel et al. 1999), there was little information in the literature that examined changes or potential changes in learning styles longitudinally over time. This researcher did not find any studies that examined a cohort group as they moved from students to graduates as was done in this study (Group E were measured in September 1995 as fourth year PT students and were measured again in April 1998, two years after graduation).

Objectives of the study

The objectives of this study were:

(a) to determine the learning style of students in the Physical Therapy program at the University of Alberta, and to examine if their learning styles changed over time during their program,

(b) to determine the learning style of practicing physical therapists and examine if their learning styles differ from physical therapy students, and

(c) to determine if there are gender differences in the learning style of physical therapy students and practicing physical therapists.

The Department of Physical Therapy at the University of Alberta believes that if student centred learning is a more appropriate way to learn the knowledge, skills and attitudes in certain professional courses (e.g., Physical Therapy or Rehabilitation courses) (Wessel et al. 1999), then the teaching and learning strategies utilized should reflect that belief. By teaching students using methodologies that are similar to how they will learn in clinical practice, and how they will treat patients, we will be more closely aligning the concept of putting theory into practice.

By examining student learning styles longitudinally, we may more closely determine if learning styles change over time, and if so, why. If there is no demonstrated significant change, it may reflect what Kolb (1984) suggested — that to be effective learners, we use all four learning styles to a certain degree:

> New knowledge, skills, or attitudes are achieved through confrontation among four modes of experiential learning. Learners, if they are to be effective, need four different kinds of abilities — concrete experience abilities (CE), reflective observation abilities (RO), abstract conceptualization abilities (AC), and active experimentation abilities (AE). (p. 30)

If there is a change, is it due to student maturity and experience, or is it due to exposure to different teaching methods? Or is it, as Kolb (1984) suggested, that learning styles are associated with patterns of behaviour: personality type, early educational specialization, professional career, current job, and adaptive competencies. If one's pattern of behaviour changes over time, so might their learning style. Also it could be argued that if people's experiences change over time, so might their learning style. Students in the Physical Therapy program at the University of Alberta gain more clinical experience in the third and fourth years of the program because that is when they do the majority of their clinical placements. The teaching methods used by some faculty members are different later in the program than at the beginning of the program. Perhaps that also facilitates a change in learning behaviour.

If the learning styles of physical therapy students are different from practicing physical therapists (PTs), it may well be because after graduation PTs appear to learn in ways that are more consistent with how they practice — which is experiential learning. Students will often find the best way to learn regardless of the teaching method or context. However, PTs who are in daily contact with patients are solving problems and learning more or less on the job, thus any preferred learning style that is not "hands on" may need to change simply to meet educational and professional (clinical) demands.

In summary, this study was designed to determine the preferred learning styles of students in a physical therapy program, and to see if and how those learning styles changed during their program. The study also determined the preferred learning styles of two groups of practicing physical therapists, and comparisons were made between students and practicing physical therapists. In Chapter Two, a review of the current literature is presented with emphasis on learning styles and a review of experiential learning theory. Particular attention is paid to the literature that describes physical therapy students and what is known about their learning style preferences. Chapter Three contains the design and methodology of the study. The tool used by this researcher to examine learning styles was the Learning Style Inventory (LSI) by David Kolb (1984). The LSI is examined and discussed in detail in Chapter Three. The results are presented in Chapter Four, followed by discussion, conclusions, and implications in Chapter Five.

Chapter 2

REVIEW OF THE LITERATURE

The review of the relevant literature addresses three topics, with a particular focus on physical therapy education: (a) teaching methods and strategies, (b) learning styles of students, and (c) the contributions of learning theory to practice.

TEACHING METHODS AND STRATEGIES

> ***"No problem can stand the assault of sustained thinking."***
>
> Voltaire

Learning strategies and teaching methods are not synonymous. The way one teaches is not necessarily the best way for others to learn. However, one of a teacher's goals should be to make the learning process as efficient and effective as possible. To accomplish this, individual student learning styles must be recognized (Coker, 1996). For the purposes of this study, learning strategies are considered to be any behaviours or thoughts that facilitate encoding in such a way that knowledge integration and retrieval are enhanced (Weinstein, 1988).

Teaching strategies or methods are many in design and structure. Again, for the purposes of this study, the focus will be on the types of teaching strategies that would facilitate the learning that is best suited for a profession such as physical therapy.

Student centred learning

Student centred learning is an approach to teaching and learning that focuses on the method of learning the student is engaged in rather than the content of the course. There are several good examples of the student centred (SC) approach to teaching. Two of the more common approaches are problem-based learning and inquiry-based learning.

(i) Problem-based learning

One of the most common methods of student centred learning is problem-based learning (PBL) which has been described in different forms in the literature. Early definitions, such as the one from Barrows and Tamblyn (1980) describe PBL as an approach in which students learn through their attempts to solve given problems in certain situations. The teacher provides relevant clinical situations to direct students to determine the knowledge and skills they require to solve the range of problems embedded in the situation. PBL is an educational process where learning is centred around problems as opposed to discrete subject-related courses (Solomon, 1994).

Albanese and Mitchell (1993) reviewed all of the available PBL literature from 1972, and contend that problem-based learning "at its most fundamental level is an instructional method characterized by using patient problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences" (p. 53). Problem-based learning is reported to challenge students to take a deeper approach to their studies (Albanese & Mitchell, 1993; Barrows, 1985; Barrows & Tamblyn, 1980; Boud &

Feletti, 1991; Ferrier, 1990; Norman, 1988; Vernon & Blake, 1993). As a result, they develop a wider range of knowledge, apply it to the situation and acquire appropriate skills. Knowledge and skills become integrated for use in decision making in clinical situations. Advocates of PBL suggest that graduates from such programs will demonstrate improved problem-solving skills, will display superior interpersonal skills, as well demonstrate better integration of clinical skills and academic content than those from traditional programs (Solomon, 1994). Walton and Matthews (1989) suggested that PBL was instituted in physical therapy programs in response to the observation that students entering the clinical setting could not incorporate previously acquired knowledge into patient care activities.

Solomon (1994) pointed out that there are few physical therapy programs with a problem-based curriculum. However she suggested that many of the issues and philosophical assumptions that persuaded medical education to adopt the PBL approach are applicable to physical therapy education. "The need to develop life-long learning skills, to focus on the educational process, to present relevant, integrated information to our students and to consider alternatives to expanding our curricula are significant concerns for physical therapy educators" (Solomon, 1994, p. 51).

(ii) Inquiry-based learning

A second method of SC learning is inquiry-based learning (IBL), described by Feletti (1993) as:

> an orientation towards learning that is flexible and open and draws upon

> the varied skills and resources of faculty and students. Faculty are co-learners who guide and facilitate the student-driven learning experience to achieve goals of [nursing practice]. This includes an inter-disciplinary approach to learning and problem solving, critical thinking and assumption of responsibility by students for their own learning. (p. 146)

Feletti acknowledges that PBL is one of the most significant innovations in education and curriculum designs for the professions. He suggests that for the field of nursing, IBL may be more effective due to its flexibility in choice of methods of delivery, decreased emphasis on true problem-solving scenarios, and lower reliance on resource-intensive learning experiences for the students. He further contends that the following features make IBL an effective learning method:

(a) it promotes observational skills more than reading skills
(b) it relies on simulations or experiences rather than case studies;
(c) it fosters student-directed learning to a great degree
(d) it allows the student to reflect on the learning process and learning experiences as a whole.

Effects of student centred learning

Boud and Feletti (1991) describe some of the more compelling features that would indicate a PBL/IBL (active learning) approach would be of benefit to the University of Alberta Physical Therapy program:

1. It takes account of how students learn. It is becoming increasingly

apparent that learning takes place most effectively when students are actively involved and learn in the context in which knowledge is to be used.

2. The expanding knowledge base of most professions means that it is impossible to include all the knowledge that is required for the beginning practitioner in the preservice curriculum. It is more important for students to be able to learn quickly, effectively and independently when they need it, than it is for them to have assimilated (at graduation) all the information that their teachers believe is desirable.
3. It supports the view of many professionals about what constitutes their field of activity, in contrast to the curriculum they experienced as neophytes in the profession. The problem-based course has high face-validity for practitioners.
4. It fits well with the political exigencies of higher education institutions: [in particular] the need to respond to changes in professional practice, to update both content and method in the light of changing learning environments, and to regenerate enthusiasm among faculty in the face of a tight economic future.
5. Most importantly, despite the apparently different demands which problem-based learning places on an institution compared with the traditional lecture/lab/tutorial structure, it is sufficiently adaptable to accommodate some of the inflexible features of course structure and

organization. (p. 17)

While there appears to be considerable support particularly in the health sciences for a nontraditional approach to teaching and learning (Albanese & Mitchell, 1993; Feletti, 1993; French, 1989; Norman, 1988; Rouse, 1990; Solomon, 1994; Vernon & Blake, 1993), there are certain negative findings as well. The review by Albanese and Mitchell (1993) also cites that at times, PBL students:

(a) score lower on basic sciences examinations

(b) perceive themselves as less prepared in the basic sciences

(c) tend to use more "backward reasoning" than "forward reasoning" — more commonly used by experts

(d) tend to have gaps in their cognitive knowledge that may affect future practice.

Solomon (1994) suggests that while there is evidence accumulating which states there are some distinct advantages to PBL, the lack of rigorous long-term data to demonstrate significant differences may be a significant obstacle to those considering educational alternatives.

Titchen and Coles (1991) compared physiotherapy students' approaches to studying in subject-centered and problem-based courses. The students' study approaches at the subject-centered school in England were measured by a validated inventory, and these were then compared with published data from students who had attended a problem-based school in Holland. The findings suggest differences between students' approaches to studying at the two schools. At the beginning of year one, students in the problem-based program exhibited apparently more desirable study profiles than students in the subject-centered program. At the end of year one, the situation was similar but less clear. By the end of year two, the students at the subject-centered school were adopting considerably more desirable study approaches than the students in the problem-based program.

The authors speculated that the reason for this apparent shift in results is probably due to a combination of factors. While the problem-based school introduced the students to problem-solving scenarios in year one, these same students did not have the opportunity to see real patients until the beginning of year three. The subject-centered students on the other hand, were exposed to patients in year two after learning about conditions and patient assessment in year one. Titchen and Coles (1991) suggest that "when students begin working with actual patients, their clinical experience might provide a concrete context for understanding the theory underpinning practice" (p. 130). Further, the authors felt that "when the subject-centered students revisit theory learned in the first year as part of their preparation of an 'ideal case,' they are recycling knowledge and using it in a way that is relevant to practice" (p. 130).

Tolnai (1991) conducted a survey of medical graduates of McMaster University and the University of Ottawa and found that teaching-learning methods employed in undergraduate education do not necessarily influence career choice and continuing medical education (CME). Because there was no difference in job choice or attendance at CME between graduates from problem-based versus traditional curricula, she determined that other factors such as admission requirements and student's attitudes influence (medical) career choice and participation in continuing medical education.

Tolnai's (1991) findings may well raise some questions, if not some concerns. The literature does not unequivocally support PBL, so why do certain schools and programs adopt that teaching and learning style? With the high cost of resources and the steep learning curve for both students and faculty, why take such a risk when the traditional way of teaching and learning has been shown to work? Perhaps part of the answer lies in the methods by which clinical professionals think students would learn best. In physical therapy, a considerable amount of learning and skill acquisition is done, not only in the classroom, but also in the physical therapy departments of hospitals, extended care facilities, and private practices. In these settings the clinicians (clinical instructors) help to teach the students by having the students treat actual clients. The on-going process of assessment, treatment planning, specification of outcome effectiveness and discharge planning is determined primarily by a problem-solving approach. Therefore it is relevant to consider the same teaching and learning style in both the classroom and the laboratory.

LEARNING STYLES

"Whatever is good to know is difficult to learn."

Greek proverb

Learning style

Learning style can be defined as a personally preferred way of dealing with information and experience that crosses content areas (Della-Dora & Blanchard, 1979). Learning style is a composite of factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. Learning style is a construct that attempts to explain the preferred process of learning. Celli Sarasin (1998) suggests "the concept of 'learning style' is a certain specified pattern of behaviour and/or performance according to which the individual takes in new information and develops new skills, and the process by which the individual retains new information or new skills" (p. 1). Messick (1976) states "each individual has preferred ways of organizing all that he sees and remembers and thinks about" (p. 4). The consistent individual patterns or differences in the organization and processing of information and experience can be examined, measured and categorized.

Learning style, while individual, can be assessed, analyzed and understood in various ways. Celli Sarasin (1998) suggests that learning can be analyzed and understood in one of 3 ways:
(a) according to the primary sense involved (visual, auditory and kinesthetic),
(b) according to psychological aspects of perception, and (c) according to the

method of processing information.

Several authors have developed definitions for specific preferences of learning theories. Garity (1985) states that learning style is “our preferred manner of processing information” (p. 12). Smith (1982) defines learning style as “characteristic ways of information processing, feeling, and behaving in and toward learning situations” (p. 60). Keefe (1982) conceptualizes learning styles as “cognitive, affective, and physiologic traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (p. 44). Researchers have approached the study of learning style preference related to a person’s preferred cognitive style, information processing strategy, social interaction, and learning environment.

Cognitive style

In contrast to cognitive ability, cognitive style is the manner in which an individual executes cognitive tasks (Farina, 1997). Richter (1992) presented a critical assessment of cognitive style where she defined cognitive style as “manifestations of individual differences in the execution of cognitive tasks, or typical and preferred modes to spontaneously process information, with individual differences in methods of achieving a constant level of competence” (p. 26). She further pointed out that cognitive abilities scales are unipolar, while cognitive styles are measured along a bipolar continuum, with one extreme at one end and the opposite extreme at the other end. Following an examination of cognitive styles and learning styles, Richter (1992) developed cognitive style criteria, which must satisfy the following:

(a) it has bipolar dimensions,

(b) it indicates the typical and preferred modes of information processing,

(c) these modes are value-differentiated, meaning both ends of the dimension have strengths and weaknesses, and

(d) the dimensions have a broad range of applications occurring across ability, cognitive personality and interpersonal domains.

Gregorc (1982) proposed cognitive or mind styles which are based on the crossing of two poles — sequential or random processing as one dimension and concrete or abstract as the two poles of a second dimension. Gregorc's four cognitive styles were summarized as learning styles by Butler (1988) as follows:

> The concrete sequential learner is structured, practical, predictable and thorough.
>
> The abstract sequential learner is logical, analytical, conceptual and studious.
>
> The abstract random learner is sensitive, sociable, imaginative and expressive.
>
> The concrete random learner is intuitive, original, investigative and able to solve problems (p. 31)

The Kolb (1984) learning style construct dimensions appear to be similar to those described by Gregorc, although he uses the terms abstract and concrete differently. Kolb stated that an orientation toward abstract conceptualization focuses on using logic, ideas and concepts. It emphasizes thinking as opposed to feeling. At the other end of the spectrum, an orientation toward concrete experience focuses on being involved in experiences and dealing with human situations in a personal way. It emphasizes feeling as opposed to thinking.

Kolb's Learning Theory

Kolb's definition of learning style exemplifies experiential learning. His experiential learning model is derived from a model of social learning that connects variability of individual learning style to flexibility in learning context (Anderson and Adams, 1992). It draws heavily from the works of Dewey, who emphasized the need for learning to be grounded in experience; Lewin, who stressed the importance of being active in learning; and Piaget, who described intelligence as the result of the interaction of the person and the environment (Claxton & Murrell, 1987). Kolb (1984) described learning as a four-step cycle based on the relationship of two dimensions of cognitive growth and learning: the concrete-abstract dimension and the reflective-active dimension. His model of experiential learning suggests the learning process requires both dimensions, and that the steps of the four-stage cycle emphasize different learning preferences. He describes four types of learning abilities: (a) Concrete Experience (CE) — feeling, (b) Reflective Observation (RO) — watching, (c) Abstract Conceptualization (AC) — thinking, and (d) Active Experimentation (AE) — doing. Using Concrete Experience, individuals immerse themselves affectively in the immediacy of the learning experience. Those preferring Abstract Conceptualization take a rational and logical approach. With Reflective Observation a person impartially views a situation from many different perspectives. Those using Active Experimentation risk active participation in learning with a “hands on” approach. Kolb suggests that typically, an individual follows the steps of the four-stage cycle in the following order: (a) concrete experience is followed by (b) observation and reflection, leading to (c) formation of abstract concepts and generalizations that result in (d) hypotheses to be tested in future actions, which in turn lead to new experiences (Kolb,1984). This is represented in Figure 2.1 as a circle or continuous learning cycle where each type of learning is connected. Learners have immediate concrete experience, involving themselves fully, and then reflecting upon the experience from a variety of perspectives. From these reflective observations, learners engage in abstract conceptualization, creating generalizations or principles that integrate their observations into theories. Finally, learners use these theories to guide them to further action, or active experimentation, testing what they have learned, only in new, more complex situations. The result is usually another concrete experience, only this time at a more complex level (Claxton & Murrell, 1987).

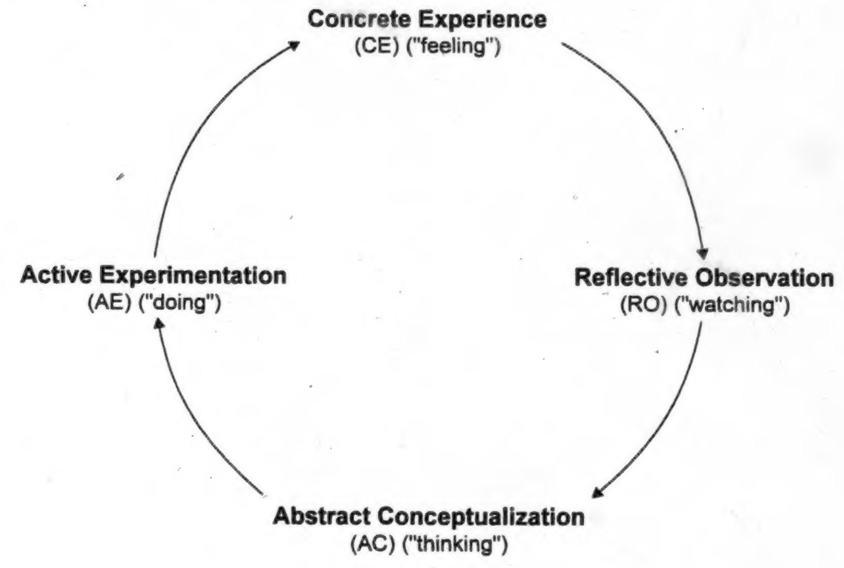

Concrete Experience
(CE) ("feeling")
Reflective Observation
(RO) ("watching")
Abstract Conceptualization
(AC) ("thinking")
Active Experimentation
(AE) ("doing")

Figure 2.1. Kolb's Four-Stage Learning Cycle (redrawn from Stice, 1987 p. 291)

Another way to look at the learning cycle is to distinguish between what Kolb sees as the two fundamental elements in the learning process. First, grasping the experience or taking in information can be done in concrete ways or more abstractly. Second, processing or transforming the experience can be done either by reflective observation of the information as it is, or by transforming the information to suit the individual's way of thinking. The vertical line in Figure 2.2 represents how we perceive information, with one extreme being concrete experience and the other being abstract conceptualization. The horizontal line in Figure 2.2 represents how we process information, with one extreme being reflective observation and the other being active experimentation. Kolb suggests that as learners, we fit somewhere along the two lines. He contends that an effective learner needs some of all four abilities, and that one can enter the cycle at any point.

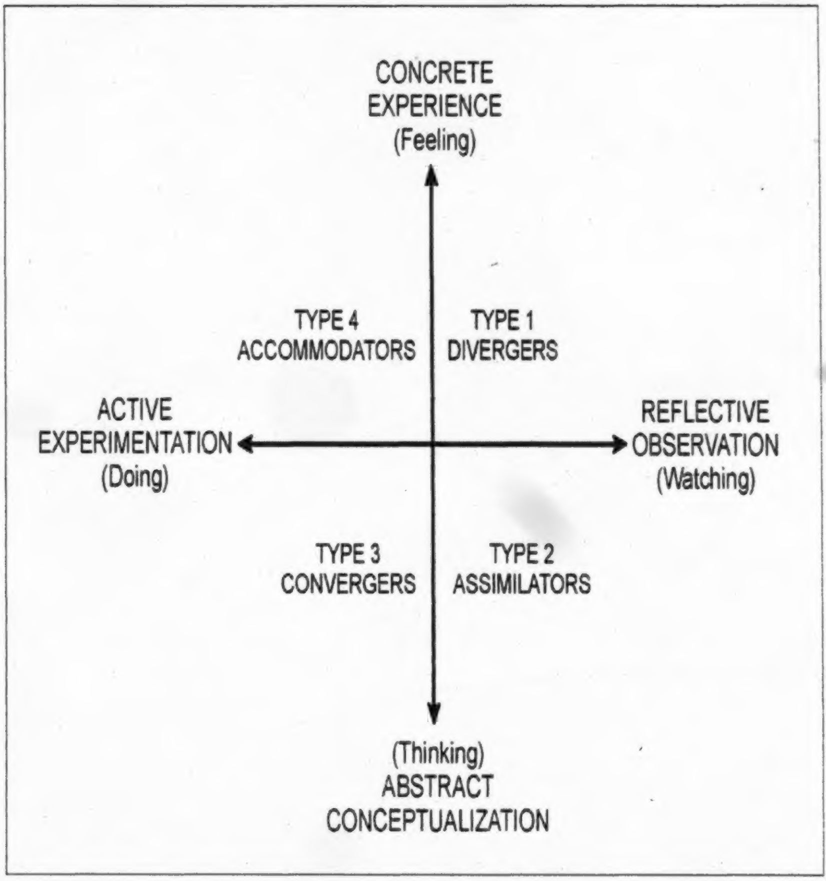

CONCRETE
EXPERIENCE
(Feeling)
TYPE 4
ACCOMMODATORS
TYPE 1
DIVERGERS
ACTIVE
EXPERIMENTATION
(Doing)
REFLECTIVE
OBSERVATION
(Watching)
TYPE 3
CONVERGERS
TYPE 2
ASSIMILATORS
(Thinking)
ABSTRACT
CONCEPTUALIZATION

Figure 2.2. Kolb's Learning Styles (redrawn from Sharp et al., 1997, p. 94)

Kolb (1984) defines learning style as "self-programming conditioned by experience that determines the extent to which the person emphasizes the four modes of the learning process: concrete experience, reflective observation, abstract conceptualization, and active experimentation" (p. 64). He developed an inventory of learning styles in which subjects rank order twelve sets of sentence completions using four words or phrases that best describe the subject's preference for learning (Kolb, 1985). Four groups were developed from this matrix: Divergers, Assimilators, Convergers, and Accommodators. The characteristics of the four groups are summarized as follows:

Divergers grasp the learning experience through concrete experience and transform it through reflective observation. Their major strength is their imaginative ability. They prefer to view situations from a variety of perspectives and then from these different relationships create a meaningful whole. They are good at generating ideas and brainstorming.

Assimilators grasp the learning experience through abstract conceptualization and transform it through reflective observation. Their primary strength is their ability to create theoretical models. They like to assimilate diverse information into an integrated whole. They tend to be less interested in people than in abstract concepts, and they focus more on the soundness of ideas than on the practical application of ideas.

Convergers grasp the learning experience through abstract conceptualization and transform it through active experimentation. Their strength is moving quickly (converging) to find the one correct answer or solution when presented with a problem or task. They tend to be less emotional and prefer dealing with things rather than people.

Accommodators grasp the learning experience through concrete experience and transform it through active experimentation. Their strengths are focussing on doing things and having new experiences. They are risk takers, but are called Accommodators because they do well in situations where they must adapt to meet new circumstances. They are intuitive, often using trial and error to solve problems. They are often impatient and when confronted with a theory that does not match the facts as they see them, they often discard the theory (Claxton & Murrell, 1987). These 4 styles are represented in Figure 2.2.

Kruzich, Friesen and Van Soest (1986) describe the process of experiential learning (à la Kolb) as follows:

> The learner must be able to get fully and openly involved (Concrete Experience), to reflect upon and interpret these experiences (Reflective Observation), to create concepts that integrate these observations into logically sound theories (Abstract Conceptualization), and to use these theories to make decisions and solve problems (Active Experimentation). (p. 23)

Learning styles of physical therapy students

Physical therapy (PT) programs are normally found in colleges or universities. PT programs can be either undergraduate or graduate. Physical therapy student learning style preferences have been examined using a variety of instruments. The learning styles of physical therapy students have been examined and measured since Payton first described them in 1979. Table 2.1 identifies the variety of learning style measurement instruments used.

Table 2.1

Learning style measurement tools used in physical therapy

Author(s)	**Learning style measurement instrument**
Payton et al. 1979	Canfield and Lafferty Learning Styles Inventory
Weber at al. 1996	Dunn & Dunn Productivity Environmental Preference Survey
Van Langenberghe 1988	Entwistle Short Inventory of Approaches to Studying
Hick-Rheault 1990	Grasha-Reichmann Student Learning Styles Scale
Barris et al. 1985; Vittetoe 1983	Rezler-French Learning Preference Inventory
Gaden 1992; Olson 2000; Rahr 1988	Gregorc Learning Style Delineator
Barb et al. 1997; Daniel 1999; Farina 1997; Katz & Heimann 1991; Pisarski 1994; Sandmire et al. 2000; Wessel at al. 1999	Kolb Learning Style Inventory

Payton et al. (1979) assessed 1099 first year physical therapy students' learning styles using a learning styles inventory developed by Canfield and Lafferty. They found that the typical first year PT student had a high preference for course work that was logically and clearly organized with specific assignments given. These students enjoyed working with people and preferred to learn through listening and direct experience. The PT students in this study demonstrated great homogeneity.

Weber et al. (1996) used Dunn and Dunn's Productivity Environmental Preference Survey (PEPS) to determine the learning style preference of 78 students entering a physical therapy program. Descriptive data revealed that 77% of the students indicated a strong need for structure in their learning environment. Forty-four percent indicated a strong need to have an authority figure accessible, and 22% showed a strong tactile preference. Thirty-seven percent of the students had a strong preference towards auditory learning compared to only 5% for visual learning.

Van Langenberghe (1988) adopted the Entwistle Short Inventory of Approaches to Studying tool to investigate the approaches to studying of first and second year PT students in a problem-based program in the Netherlands. There were no differences between the 99 first year and 88 second year students who responded to the questionnaire in terms of their approaches to studying. The author concluded that both groups possessed desirable approaches to learning, including being better organized, working more regularly and effectively, and showing more drive to achieve than a sample of other students in higher education.

Hick-Rheault (1990) used the Grasha-Riechmann Student Learning Styles Scale (GRSLSS) to determine the learning styles of 147 physical therapy students in three Illinois colleges over a two year period. She found that the learning styles changed over time during college. Some changes were common across programs, while others were specific to the particular program that the students attended. Her contention was that changes in learning style occurred due to the influence of the programs and institutional differences in the state of Illinois.

Vittetoe (1983) used the Rezler-French Learning Preference Inventory to determine the learning styles of 32 undergraduate and nine graduate PT students. The results demonstrated that the students first preference was on the concrete scale (preference for learning tangible, specific, practical tasks, with focus on skills), and their second preference was on the teacher-structured scale (preference for learning in a well-organized, teacher-directed class with expectations, assignments, and goals clearly identified).

Barris et al. (1985) compared the learning styles of undergraduate physical therapy students, undergraduate occupational therapy students and graduate occupational therapy students using the Rezler-French Learning Preference Inventory. All 3 groups conformed to a profile of preferring teacher-structured, concrete, interpersonal learning, however the occupational therapy students had significantly higher sub-scores on the teacher-structured scale than the other groups.

Several authors have used the Gregorc Learning Style Delineator. The Gregorc tool classifies subjects into four distinct learning styles: abstract-random, concrete-sequential, abstract-sequential, and concrete-random. Rahr (1988) found that learning styles were related to undergraduate majors. He studied the learning styles of junior and senior allied health students, including physician assistants, nurses, physical therapists, occupational therapists and medical technologists. Rahr found the predominant learning style (for PT students and medical technology students) was concrete-sequential, while occupational therapy students were mostly abstract-random. He also found that the favourite learning strategies for the majority of students surveyed were note-taking, lectures, and laboratory classes.

Gaden (1993) used the Gregorc in his study of four groups of PT students (two groups of undergraduates and two groups of graduates). Gaden found that in 59% of the students surveyed, two learning styles emerged to be more common: concrete-sequential and abstract-random. His results showed that the concrete-sequential dominant learner prefers a classroom where the teacher is in charge and content is presented in a logical manner.

Olson (2000) also used the Gregorc Learning Style Delineator to examine the learning styles of 190 post-baccalaureate PT students. She tested the assumption that students' learning styles express themselves in preference for various teaching methods and instructional activities. The predominant learning style was the concrete-sequential, and a high percentage (34%) exhibited a dual style of concrete-sequential and abstract-random, which supports the findings of Gaden (1993).

The Kolb Learning Style Inventory (Kolb, 1985) has been used more than any other instrument to measure the learning styles of physical therapy students. It is an ipsative instrument which categorizes one's learning style preference into one of four categories: Accommodator (combines feeling with doing); Assimilator (combines thinking with watching and listening); Converger (combines thinking with doing); and Diverger (combines feeling with watching and listening). Barb et al. (1997) completed a two year longitudinal study of physical therapy students entering and exiting a master's level physical therapy program. They found the majority of students were Assimilators both at entrance (36.0%) and at exit (33.3%). They also found a significant difference in combination scores for both males and females from entrance to exit. There was a shift in scores for male students toward the reflective orientation while the females shifted more toward the active orientation. They could not determine whether this shift was due to academic or clinical learning.

Daniel (1999) investigated the relationship between learning style, two learning environments (synchronous interactive television and computer aided instruction) and student achievement of physical therapy students enrolled in a distance education course. The majority of the 64 PT graduate students interviewed were Convergers (39%) and Assimilators (33%). The preferred mode of learning for Convergers in both treatment conditions was abstract conceptualization and active experimentation.

Farina (1997) identified the learning styles and study approaches of 660 physical therapy students in Australia, Canada, and the United States using the Kolb LSI. Those physical therapy students were found in both bachelor's and master's physical therapy programs. Despite differences across the samples, students in each country were found to prefer the Converger and Assimilator learning styles.

Katz and Heimann (1991) used the Kolb LSI to determine the learning styles of students and practitioners in five health professions (clinical psychology, nursing, occupational therapy, physical therapy, and social work) in Israel. They reported the average of scores on the learning modes rather than the number of students in each of the four learning styles. The 'average' learning type was Converger for physiotherapy students and Assimilator for physical therapy practitioners.

Pisarski (1994) studied first and second year PT students in a two year post-baccalaureate degree program (entry-level masters). Seventy one students were polled using the Kolb Learning Style Inventory (LSI). The majority of students were found to be Assimilators (43.6%), Accommodators and Convergers each accounted for 23.9%, and 8.4 % were Divergers.

Wessel et al. (1999) used the Kolb LSI to determine the learning styles of 158 physical therapy students in the second, third and fourth years in a four year baccalaureate program. They found the majority of students had the preferred learning style of Assimilator or Converger, regardless of year in the program. These students preferred to learn a theoretical base and then reflect on or experiment with it.

Sandmire et al. (2000) examined the influence of individual learning style preference on collaborative performance in 78 occupational and physical therapy students. They were randomly assigned in pairs to one of three subsets based on their Kolb LSI scores (active experimenters vs reflective observers). These authors did not determine the learning style preference in their study but rather used the LSI X and Y axis scores to categorize and group the students. Learning style did not contribute to any difference between student groups' performances on a case exercise.

Learning style preference and gender

Several authors (Baxter Magolda, 1989; Kolb, 1984; Meyer, Dunne & Richardson, 1994; Pinto, Geiger & Boyle, 1994; Richardson & King, 1991; Severiens & Ten Dam, 1994; Vernon-Gerstenfeld, 1989) have examined gender differences and learning style preference. Kolb (1984) found that women prefer concrete learning styles, whereas men more often adopt abstract modes of learning. Vernon-Gerstenfeld (1989) reported that women were slightly more reflective in their learning style than men. Baxter Magolda (1987) found that more women preferred concrete experience (59%) compared to abstract conceptualization (41%), whereas men were more evenly divided in this dimension. However she reported that these differences were not statistically significant. Pinto et al. (1994) examined a group of business students over a three year time frame. They found that the two largest groups were comprised of Assimilators and Convergers, however there were no differences by gender on any of the four learning attributes for all three administrations of the instrument. In a meta-analysis of Kolb's LSI with respect to gender, Severiens and Ten Dam (1994) found a small consistent gender difference indicating that men showed a greater preference than women for the abstract conceptualization mode of learning.

In summary, learning styles have been determined and examined in many different fields and contexts, including physical therapy. Learning styles of both students and practitioners have been examined. One study compared students to practitioners, and a few studies have examined learning styles over time. Several studies have examined the effect of gender on preferred learning style. The learning styles of physical therapy students have been examined several times over the past 20 or so years. More than half of the studies have used the Kolb LSI to measure learning style preference. These results have demonstrated quite distinctly that most of the PT students prefer the Converger or Assimilator learning style. This means that they prefer a learning style in which they combine abstract conceptualization (thinking) with either reflective observation (watching and listening) or with active experimentation (doing).

CONTRIBUTIONS OF LEARNING THEORY TO PRACTICE

"He who loves practice without theory is like a seafarer who boards a ship without wheel or compass and knows not whither he travels."

Leonardo da Vinci

Given the explosion of knowledge in this information era, faculty and students must acknowledge that all content cannot be taught. **What** is learned — the content — is facilitated by **how** it is learned — the method or process of learning. The method of teaching and learning recommended for a given curriculum should aim to foster information processing by students at higher levels, such as at application, synthesis, and integration levels, rather than at the lower levels of recall and comprehension (Department of Physical Therapy, 1996). Moreover, the method of teaching and learning recommended for our Physical Therapy program involves students as active participants in their learning rather than as passive recipients of information provided by instructors. To this end, students must be challenged to identify learning needs, access information sources, critically analyze information, and integrate and apply information to the learning situation.

Cevero (1992) suggests "although everyone agrees that professionals learn from practice, the debate becomes interesting when a model of learning from practice is juxtaposed against other models of learning in the fight for the hearts, minds and dollars of those who control professional education programmes" (p. 92). Cevero's contention appears to be that learning for professionals stems from a symbiotic interrelationship between classroom teaching and clinical teaching. French, Neville, and Laing (1994) agree, in that they contend that [physical] therapists "should aim to help learners enrich their knowledge by linking new with existing material, challenging prevailing ideas, and forming bridges between theoretical and practical information" (p. 4).

One may speculate whether there is a similar relationship between an instructor's conceptions and orientations to teaching and the way courses are actually taught: this relationship might in turn, affect the quality of student learning. Kember and Gow (1994) examined this relationship and found that teachers in institutions of higher learning demonstrate two orientations to teaching: "learning facilitation" and "knowledge transmission." The learning facilitation orientation is made up of five subscales: (a) problem solving, (b) more interactive teaching, (c) facilitative teaching, (d) pastoral interest, and (e) motivation of students. The knowledge transmission orientation has four subscales: (a) training for specific jobs, (b) use of media, (c) imparting information, and (d) knowledge of subject (Kember & Gow, 1994, p. 59). Kember and Gow found that the methods of teaching adopted, the learning tasks set, the assessment demands made, and the workload specified are strongly influenced by the orientation to teaching. They found that in departments where the knowledge transmission orientation predominates, the curriculum design and teaching methods are "more likely to have undesirable influences on the learning approaches of the students, whereas departments with a greater propensity towards learning facilitation are more likely to design courses and establish a learning environment that encourages meaningful learning" (p. 69).

While it is recognized that professional requirements for physical therapists overlap considerably with generic university attributes, physical therapists as professionals need to be able to demonstrate the ability to engage successfully in self-directed and lifelong learning, to contribute to the development of the knowledge base of physical therapy, and to practice in a manner which demonstrates autonomy, competence and accountability (Hunt et al. 1998). It is recognized that professional education is distinguished by the necessity to enable students to apply conceptual knowledge to specific situations in which idiosyncratic variables seem to defy linear thinking. Vayda and Bogo (1991) contend that:

> Critical analysis and deliberate integration of knowledge may be divorced from the practicum and practiced mainly in the classroom, whereas practice itself may become imitative. The integration of theory and practice demands reformulation of knowledge, self-knowledge, and critical analysis if it is to succeed. (p. 271)

Although Vayda and Bogo relate this to social work, it can also relate to other professions. This integration may also require a shift in both teaching and learning styles by the students and the teachers. As Kruzich et al. (1986) explain, "clearly, any approach to improving professional education must take into account at least three dimensions:

1) the nature of the knowledge and skills to be taught;

2) the methods by which information and skills are transmitted; and
3) students' characteristic ways of learning" (p. 22).

These authors suggest that learning style is the key ingredient in the complicated process of preparing students for professional practice.

If it is believed that the purpose of teaching is to promote learning, then we must be as cognizant of the ideologies and methods of learning as much as we must be cognizant about the ideologies and strategies of teaching. In that sense, meaningful learning occurs when learners retain a concept by relating it to what they know, thereby making sense of it. Each view of learning should prompt educators to reflect on how they are influencing students' learning and what teaching strategies are best suited to their students' learning needs. To prepare physical therapy students for the future, educators must attend to the issues of both content and process of learning, identifying what is required and how it is best achieved (Hunt et al. 1998).

While research has shown that students learn in a variety of ways and that each student has a preferred style of learning, the effectiveness of teaching may be enhanced by attempting to teach to each of the preferred styles at least a portion of the time. Harb, Durrant and Terry (1993) examined Kolb Learning Styles of engineering students and devised a model of teaching and learning in an attempt to meet both the needs of the students and the curriculum. They devised a set of teaching objectives for each of the four quadrants in Kolb's Learning Theory. This was conceptualized diagrammatically by Wessel et al. (1999) as seen in Figure 2.3. Beginning in the inner upper right hand corner of

Figure 2.3 and moving in a clockwise direction, they refer to the quadrants as Why?, What?, How? and What if? The majority of physiotherapy students in the study by Wessel et al. (1999) would be good at the 'What' and 'How', but would require more help with the 'Why' and the 'What if'.

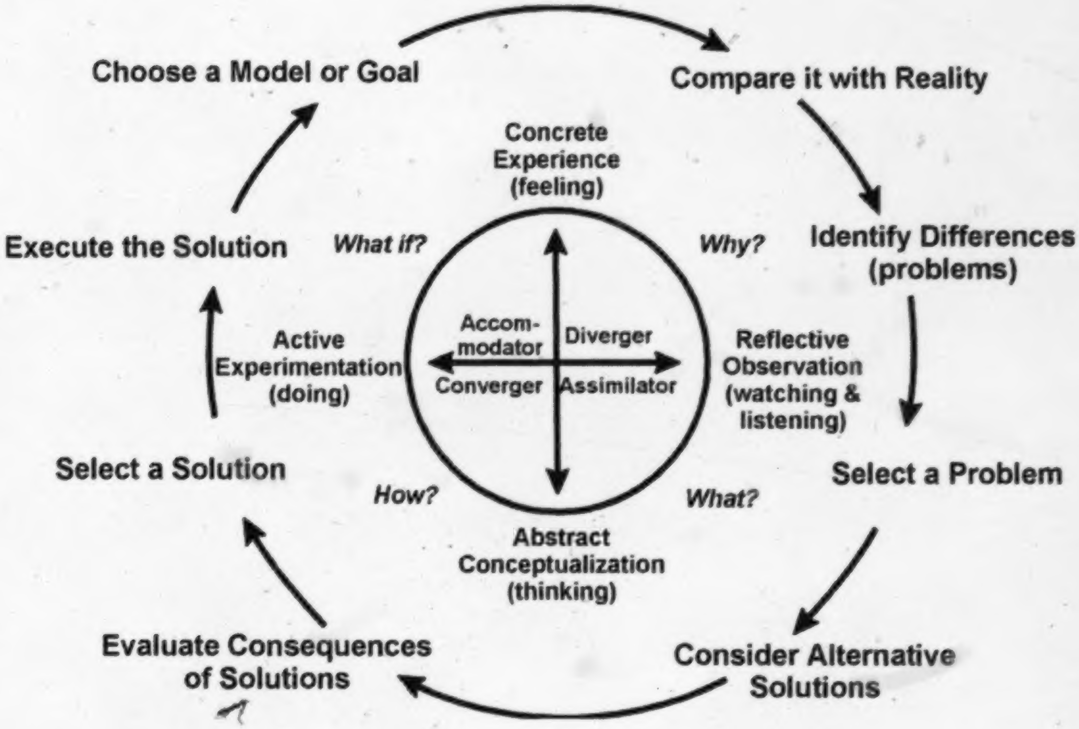

Choose a Model or Goal
Compare it with Reality
Concrete Experience (feeling)
Execute the Solution
What if?
Why?
Identify Differences (problems)
Active Experimentation (doing)
Accom-modator
Diverger
Converger
Assimilator
Reflective Observation (watching & listening)
Select a Solution
How?
What?
Select a Problem
Abstract Conceptualization (thinking)
Evaluate Consequences of Solutions
Consider Alternative Solutions

Figure 2.3. Learning styles and the problem-solving process. (From Wessel et al. 1999). From the centre to the outside of the circle, the layers represent learning styles, learning modes and problem-solving skills respectively. The words in italics are the terms used by Harb et al. (1993) to describe the quadrants of the learning cycle.

Summary

There are many teaching methods which can be effectively used in order to meet specific learning objectives as well as provide the student with variety and interest. One need only think of the old adage "don't do as I do, do as I say." However, in a clinical profession like physical therapy, teaching should reflect the methods used in clinical practice when treating patients. In physical therapy education as well as practice, the emphasis on learning is doing. Teaching methodologies that create a contextual framework for clinical learning are those that involve the student more directly in the learning process — primarily a variety of student centered approaches. Physical therapy teaching methods should reflect physical therapy practice. Student learning styles may play a role in determining how well a teaching method is perceived as being satisfactory. Students learn differently however, and in a clinical profession like physical therapy, it has been demonstrated by several authors (Barris et al. 1985; Graham, 1996; Higgs & Boud, 1991; Katz & Heimann, 1991; Morris, 1993; Titchen & Coles, 1991; Van Langenberghe, 1988; Wessel et al. 1999) that certain learning styles appear to be more conducive to certain teaching methods — particularly student centered teaching methods. Perhaps the old adage should be changed to read *"don't do as I say, do as I do."*

Chapter 3

METHODOLOGY

The objectives of this study were:

(a) to determine the learning style of students in the Physical Therapy program at the University of Alberta, and examine if their learning style changed over time during their program, and

(b) to determine the learning style of practicing physical therapists and examine if their learning style differs from physical therapy students, and

(c) to determine if there are gender differences in the learning style of physical therapy students and practicing physical therapists.

This study involved volunteer physical therapy students in each year of the four year Bachelor of Science in Physical Therapy program at the University of Alberta and two groups of volunteer practicing physical therapists (the University of Alberta PT classes of 1995 and 1996). Data were gathered on the learning styles of the four cohort groups of students (Groups A to D) and the two cohort groups of practicing physical therapists (Groups E and F). All subjects in groups A through E had their learning style measured twice for the purposes of this study. Group A students were measured in September 1997 and April 1998; Group B students were measured in January 1997 and in April 1998; Group C students were measured in January 1996 and April 1998; Group D students were measured in September 1995 and April 1998; and Group E were measured in September 1995 as students and in April 1998 as practicing physical therapists. Physical therapists in Group E and Group F graduated from the Physical Therapy program at the University of Alberta in 1996 and 1995 respectively. Group E students had their learning style measured for the first time in September 1995 while in their fourth year (as part of a previous study by Wessel et al. 1999), and they were measured again in April 1998, two years after graduation. Group F therapists (PT class of 1995) had their learning style measured only once in April 1998.

For this study, the decision was to use a learning style model that examined information processing strategies. These models deal with the way people tend to process information. The model used for this study, the Kolb Learning Style Inventory [LSI] (Kolb, 1984) is based on experiential learning. This type of learning style model fits in well with the teaching and learning environment in the Physical Therapy program at the University of Alberta.

Study design

This was a comparative study designed to examine the learning styles of physical therapy students and practicing physical therapists. To compare the learning styles of all student groups and practicing physical therapists as measured in April, 1998, a cross-sectional design was utilized. In order to study the effects of time on learning style, a longitudinal design was utilized. This design allows a cohort of subjects to be followed over time (Portney & Watkins, 2000). It was longitudinal for the data gathered for student Groups A through D, whose learning styles were measured at different times within the physical therapy program. Group E therapists (PT class of 1996) were also included in a longitudinal examination of their data, because their learning style was measured twice (fall of 1995 and spring of 1998).

All subjects were volunteers. They were not required to participate and they were allowed to withdraw at any time without consequence or penalty. All participants signed a consent form (Appendices A and B).

Ethical considerations

The research steps followed for this study complied with the University of Alberta ethical guidelines for research involving human subjects. An ethics committee from the Department of Educational Policy Studies reviewed and approved the study. All participants were informed of the purpose of the study and freely consented to participate. A copy of the approval from the Department of Educational Policy Studies ethics committee is found in Appendix C.

Research questions

The following research questions were addressed in this study:

1. Were there differences in learning style among physical therapy students across different years of the Physical Therapy program?
2. Were there differences in learning style of practicing physical therapists with different years of clinical experience?
3. Were there differences in learning style between the physical therapy students (Groups A to D) and the practicing physical therapists

(Groups E & F)?

4. Did the learning style of the physical therapy students (Groups A-D) change over time?
5. Did the learning style of practicing physical therapists (Group E) change from their last year in the physical therapy program to two years after graduation ?
6. Were there differences in learning style between male and female students?
7. Were there differences in learning style between male and female practicing physical therapists?

Data collection timetable

For Groups A through E, Kolb LSI data were collected twice (T1 and T2). Group F (PT class of 1995) had Kolb LSI data collected once (at T2). The Kolb LSI data were collected twice for groups A through E to allow for measurement of any change in learning style. Although initial learning style data were collected on different dates among the students (groups A through D) and practicing physical therapists (Group E), the final learning style data were collected at the same time for all groups (Table 3.1).

Data collection procedures

All data collection at Time 1 was done either by this researcher, or a member of a previous research team (Wessel et al. 1999). All data collected at

Time 2 was done by this researcher. The same data collection protocol was followed for each collection for students who were taking classes in Corbett Hall at the University of Alberta. For those students who were out in clinical placements, the data forms were sent to them via mail. The data collection forms were also mailed to the practicing physical therapists.

Table 3.1

Data collection timetable for all groups

Group	**Time 1**	**Time 2**
A (first year PT students)	September 1997	April 1998
B (second year PT students)	January 1997	April 1998
C (third year PT students)	January 1996	April 1998
D (fourth year PT students)	September 1995	April 1998
E (PT Class of 1996)	September 1995	April 1998
F (PT Class of 1995)	April 1998	▨

(A) Time 1

The Kolb LSI (Appendix 1) was administered for the first time (T1) in class to all students in Groups D and E as part of a previous study (Wessel et al. 1999). For Groups B and C, the Kolb was administered for the first time (T1) by a colleague as part of her normal class inventory. For Group A, the Kolb was administered for the first time (T1) by this researcher in his own class. For Group F, the Kolb was administered only once (T2) by this researcher via a mailout.

Completion instructions were provided in writing and subjects were also asked to read the instructions at the top of the Kolb LSI. Subjects were identified only by their university ID number which was to be written on the Kolb instrument. The completed forms were collected and the data were entered into a computer data base program for storage.

(B) Time 2

For Groups A and B (first and second year PT students, respectively), the Kolb was re-administered in class in April 1998, using the same procedures.

Groups C and D (third and fourth year PT students, respectively) were out on clinical placements which had commenced in February, 1998, so the Kolb was mailed to them either at home or at their clinical placement. They were asked to return the completed forms in a stamped return envelope. Two weeks after the deadline, a reminder letter and another Kolb was mailed to those who had not responded. A sample letter is found in Appendix D.

For Groups E and F (PT classes of 1996 and 1995, respectively), the Kolb LSI was mailed to them in February 1998 along with the appropriate consent forms and instructions on how to complete the Kolb LSI. These subjects were asked to identify themselves by their University of Alberta ID number. If they could not remember it, they were allowed to use their birthdate (yy/mm/dd). They were asked to return the complete Kolb LSI in a stamped return envelope. Two weeks after the deadline, a reminder letter and another Kolb was mailed to those who had not responded. A sample letter is found in Appendix E.

Dependent and independent variables

For research questions 1, 2 and 3, the dependent variable was learning style as measured by Kolb LSI scores (AC-CE and AE-RO), and the independent variable was the subject cohort group (A - F). For research questions 4 and 5, the dependent variable was learning style as measured by Kolb LSI scores (AC-CE and AE-RO), and the independent variable was time. For research questions 6 and 7, the dependent variable was learning style as measured by Kolb LSI scores (AC-CE and AE-RO), and the independent variable was gender.

Many other factors can influence how well students perform and how they feel about teaching and learning methods. Factors such as previous years of university, living away from home, independence, new friends, strange surroundings, and so on are variables that were not accounted for nor documented in this study. When examining the learning styles of practicing physical therapists, factors such as the nature of their clinical practice (private practice versus hospital or other institution), type of clientele, post-graduate education, and location were not accounted for nor documented in this study.

Delimitations

Delimitations as defined by Rudestam and Newton (1992) are those limitations "on the research design that you have deliberately imposed" (p. 73). For this study, the delimitations were as follows:

1. The longitudinal study was limited to examining any change in

learning style with five cohorts of participants (Groups A to E); there was no control group. Therefore the reason for any change in learning style from this study cannot be generalized to any other groups or individuals.

2. Only volunteers from the six different cohort groups were included in this study. The number of participants asked to volunteer varied according to the number of students in each year of the program, and the number of students who graduated from the program in 1995 and 1996. Normally, there are 66 students admitted to the first year of the PT program, and the average class size to graduate is 63. All students (Groups A to D) and former students (Groups E & F) were invited to participate in the study. The following volunteers were recruited:
   Group A: 63 first year PT students
   Group B: 52 second year PT students
   Group C: 54 third year PT students
   Group D: 51 fourth year PT students
   Group E: 41 physical therapists who graduated in 1996
   Group F: 40 physical therapists who graduated in 1995.
3. Learning style was measured only by the Kolb Learning Style Inventory (LSI).

Limitations

Limitations as defined by Rudestam and Newton (1992) are "restrictions in the study over which you have no control" (p. 74). The limitations in this study are as follows:

1. The study did not control for the effect of measurement. The LSI questionnaire was administered twice to all groups except Group F, who were measured only once. There may be a learning effect because of the repeated measures used. This learning effect may skew student's perceptions of their learning style for all groups.
2. The study did not control for within-group comparison. It was not possible to control for any contamination from other courses, or cross contamination from other groups.

The instrument: Kolb's Learning Style Inventory

David Kolb developed his Learning Style Inventory (LSI) in 1976 based on his learning theory model. Kolb (1984) felt the test should be constructed in such a way that people would respond to it in the same way as they would a learning situation. Geiger and Boyle (1993) suggest that one thesis of Kolb's learning model is that individuals need to choose between the various learning abilities in different learning situations and also as an overall strategy in the way new knowledge is acquired. It should, therefore, require one to resolve the opposing tensions between abstract-concrete and active-reflective orientations. The original instrument was developed as both an ipsative and a normative instrument. Kolb (1984) states that they were seeking a test that was both normative, allowing comparisons between individuals in their relative emphasis on a given learning mode such as abstract conceptualization, and ipsative, allowing comparisons within individuals on their relative emphasis on the four learning modes — for instance, whether they emphasized abstract conceptualization more than the other three learning modes in their individual approach to learning. It was a self-assessment tool, based on rank ordering of four possible one-word adjectives in each of nine different sets related to Kolb's experiential learning theory. In 1985 Kolb revised the instrument and changed the format from nine sets of words to twelve questions that measure an individual's tendency to prefer feeling (concrete experience), watching (reflective observation), thinking (abstract conceptualization), or doing (active experimentation). The revised Kolb LSI is comprised of a set of 12 sentences and a choice of four responses. For example: "When I learn: *I am happy; I am fast; I am logical; I am careful*" (Kolb, 1985, p. 2). The revised Kolb LSI is found in Figure 3.1.

Figure 3.1. Kolb's Learning Style Inventory: Instructions for use

LEARNING STYLE INVENTORY: INSTRUCTIONS

The Learning Style Inventory describes the way you learn and how you deal with ideas and day-to-day situations in your life. Below are 12 sentences with a choice of 4 endings. Rank the endings for each sentence according to how well you think each one fits with how *you* would go about learning something. Try to recall some recent situations where you had to learn something new, perhaps in your job. Then, using the spaces provided, rank a "4" for the sentence ending that describes how you learn *best*, down to a "1" for the sentence ending that seems *least* like the way you would learn. Be sure to rank all the endings for each sentence unit. Please do not make ties.

Example of a completed sentence set:

When I learn: ____I am happy ____I am fast ____I am logical ____I am careful

---

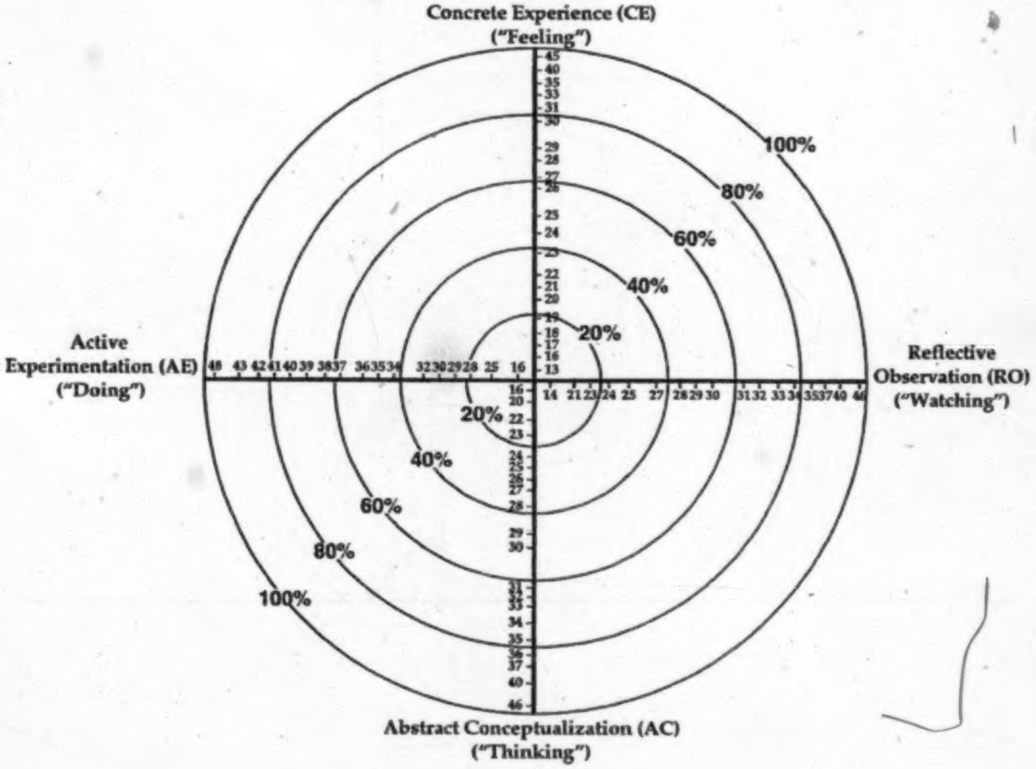
1.	When I learn:	____I like to deal with my feelings	____I like to watch and listen	____I like to think about ideas	____ I like to be doing things
2.	I learn best when:	____I trust my hunches and feelings	____I listen and watch carefully	____I rely on logical thinking	____I work hard to get things done
3.	When I am learning:	____ I have strong feelings and reactions	____ I am quiet and reserved	____I tend to reason things out	____I am responsible about things
4.	I learn by:	____ feeling	____ watching	____ thinking	____ doing
5.	When I learn:	____ I am open to new experiences	____ I look at all sides of issues	____ I like to analyze things, break them down into their parts	____ I like to try things out
6.	When I am learning:	____ I am an intuitive person	____ I am an observing person	____ I am a logical person	____ I am an active person
7.	I learn best from:	____ personal relationships	____ observation	____ rational theories	____ a chance to try out and practice
8.	When I learn:	____ I feel personally involved in things	____ I take my time before acting	____ I like ideas and theories	____ I like to see results from my work
9.	I learn best when:	____ I rely on my feelings	____ I rely on my observations	____ I rely on my ideas	____ I can try things out for myself
10.	When I am learning:	____ I am an accepting person	____ I am a reserved person	____I am a rational person	____ I am a responsible person
11.	When I learn:	____ I get involved	____ I like to observe	____ I evaluate things	____ I like to be active
12.	I learn best when:	____ I am receptive and open-minded	____ I am careful	____ I analyze ideas	____ I am practical
	TOTAL the scores from each column	|____| Column 1	|____| Column 2	|____| Column 3	|____| Column 4

(Revised from Kolb, 1985)

Kolb LSI Scoring

The revised LSI version used in this study (Kolb, 1985) [Figure 3.1] asks individuals to select words that relate to the type of learning that most closely resemble their preferred behaviour. The revised LSI uses an ipsative scoring format, one that requires the subject to respond by rank ordering the four styles according to preference (Cornwell & Manfredo, 1994). Subjects rank each of the offered responses from 1 to 4, with 1 being the least preferred way to learn and 4 being the most preferred way to learn. The instructions state that each number (1 to 4) can only be used once for each sentence. The choice that most closely resembles the person completing the instrument is given a rating of "4", the next highest given a "3", followed by a "2" and the final choice is given a "1". Since the final choice among the selections is dependent on the three previous choices, it would appear that the revised LSI produces only ipsative scores for each of the learning dimensions. This process ensures the participant's preferences in the four learning dimensions: feeling (concrete experience); watching (reflective observation); thinking (abstract conceptualization); and doing (active experimentation). There are 4 columns of 12 numbers when the Kolb LSI is completed — these columns relate to the four stages in the Cycle of Learning from Experience: Concrete Experience (CE) [column 1], Reflective Observation (RO) [column 2], Abstract Conceptualization (AC) [column 3], and Active Experimentation (AE) [column 4] (Kolb, 1985, p. 4). When the rankings are summed, the totals represent the individual's relative preference for each learning mode. Concrete Experience (CE) and Abstract Conceptualization (AC) represent opposite ends of the vertical scale, and Active Experimentation (AE) and Reflective Observation (RO) represent opposite ends of the horizontal scale. The bipolar scales representing each dimension are perpendicular, providing four quadrants, each of which represents a learning style (Kolb, 1985). The Kolb Cycle of Learning is found in Figure 3.2.

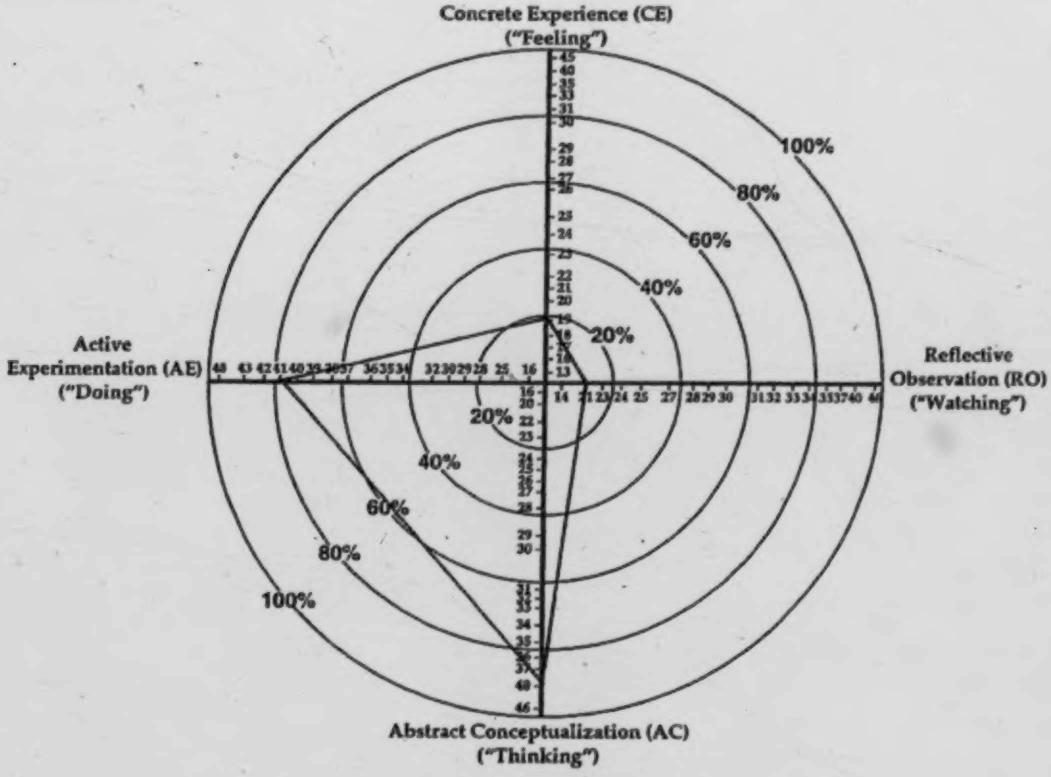
Figure 3.2 Kolb's Cycle of Learning


Concrete Experience (CE)
("Feeling")
45
40
35
33
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
13
Active
Experimentation (AE)
("Doing")
48 43 42 41 40 39 38 37 36 35 34 32 30 29 28 25 16
14 21 23 24 25 27 28 29 30 31 32 33 34 35 37 40 46
Reflective
Observation (RO)
("Watching")
16
20
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
40
46
100%
80%
60%
40%
20%
20%
40%
60%
80%
100%
Abstract Conceptualization (AC)
("Thinking")

Learning modes

In order to determine preferred learning modes, the subject takes the totals from each of the four LSI columns (column 1 [CE], column 2 [RO], column 3 [AC] and column 4 [AE]) and plots them on the horizontal (AE-RO) and vertical (AC-CE) grid lines of the Kolb LSI Cycle of Learning (Figure 3.2). By connecting the four points, you will get a "kite-like" shape. The shape and placement of this "kite" will show which learning modes are used the most and which are used the least (Kolb, 1985). This four-sided kite-like figure represents a visual diagram of the strength of each type of learning preference. The final scoring process identifies the particular quadrant that the participant lies within. It may well be that an individual may not lie completely in one quadrant, and therefore does not exhibit a singular learning style but rather demonstrates characteristics of more than one descriptor. It may well be that some learners are close to the crosshairs with a small kite, while others may appear to have a strong preference for one learning style, making the kite larger and found mostly in one quadrant. It is important to remember however that "all learning styles are beneficial in their different ways, their effectiveness varying according to the task" (French et al. 1994, p. 8). Examples of scoring on the Cycle of Learning (raw scores) are found in Figures 3.3 and 3.4. In these examples, a strong Converger learning style preference is illustrated in Figure 3.3, while a weak Assimilator learning style preference is illustrated in Figure 3.4.

Figure 3.3 Kolb Cycle of Learning Example 1



Kolb raw data scores: Column 1 (Concrete Experience): 19

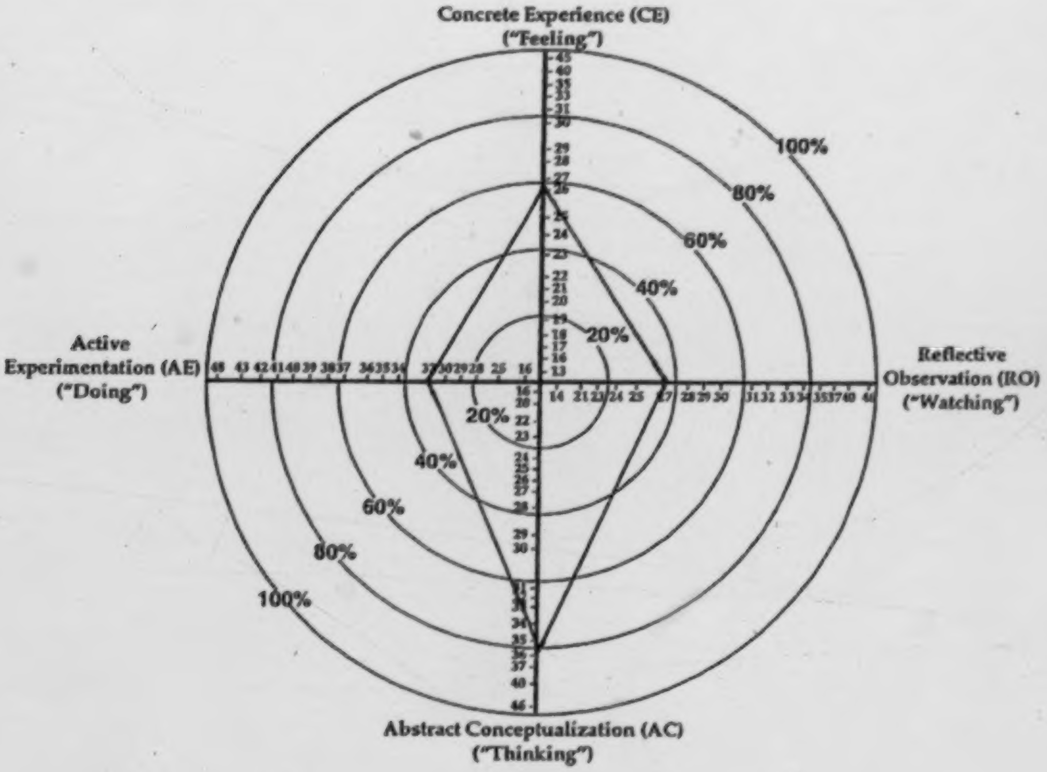
Column 2 (Reflective Observation): 21

Column 3 (Abstract Conceptualization): 39

Column 4 (Active Experimentation): 41

Learning style peference: Converger (strong); mostly Converger learning style

Figure 3.4 Kolb Cycle of Learning Example 2



Kolb raw data scores: Column 1 (Concrete Experience): 26

Column 2 (Reflective Observation): 27

Column 3 (Abstract Conceptualization): 36

Column 4 (Active Experimentation): 32

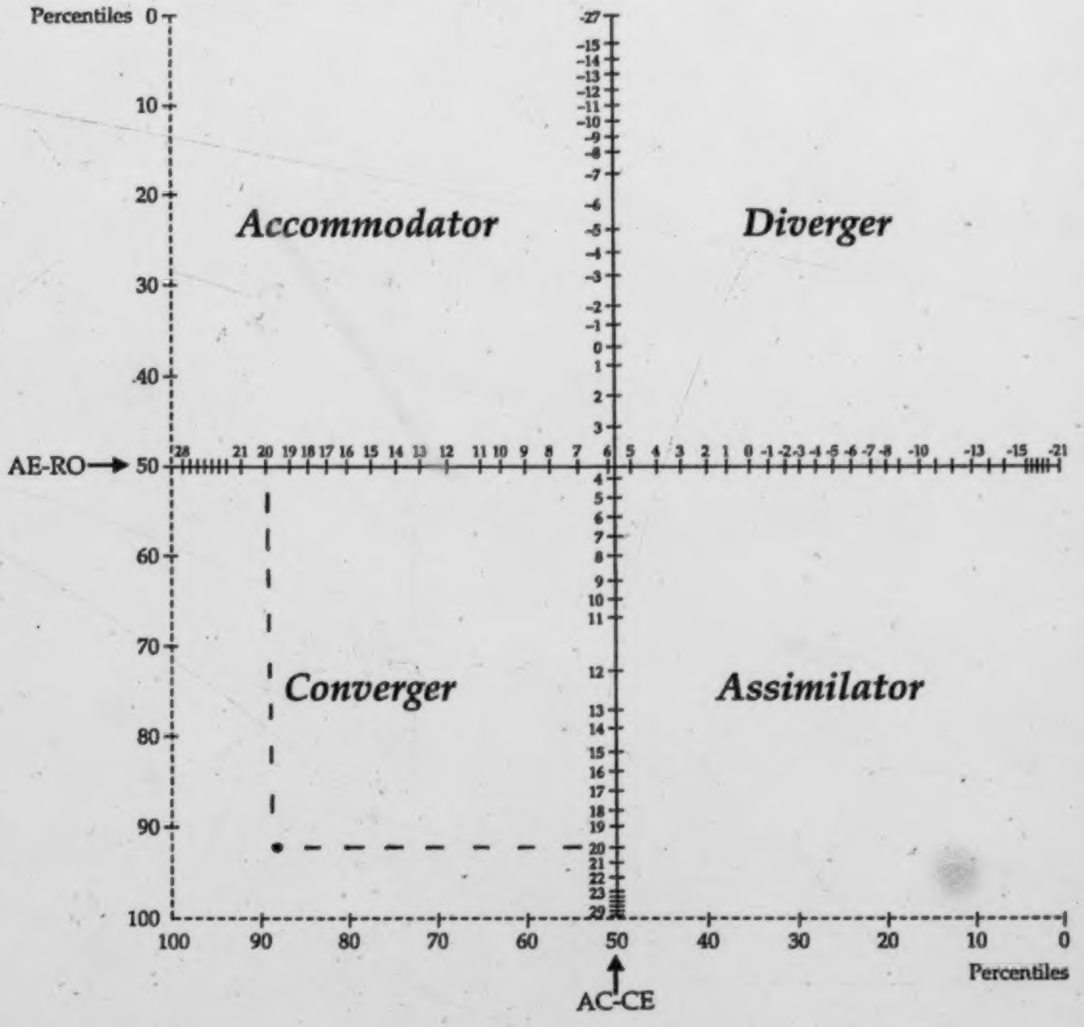
Learning style preference: Assimilator (weak); some of each learning style

Learning style

An individual's preferred learning style is then determined by taking the four raw LSI scores (learning modes) and combining them. Combination scores give strength and direction for an individual's learning style preference on the concrete-abstract dimension and the active-reflective dimension. Combination scores are determined by subtracting concrete experience (CE) from abstract conceptualization (AC) and subtracting reflective observation (RO) from active experimentation (AE). Kolb (1984) suggests that the combination scores indicate the extent to which the person emphasizes abstractness over concreteness (AC-CE) and the extent to which the person emphasizes action over reflection (AE-RO). The two combination scores AC-CE and AE-RO are then plotted on the Kolb Learning-Style Type Grid and the point of interception of these 2 scores [data point] determines to which one of the 4 learning styles the subject belongs (Kolb, 1985). The resultant values represent the four possible learning modes: feeling (Concrete Experience), watching (Reflective Observation), thinking (Abstract Conceptualization), and doing (Active Experimentation). The closer the data point is to the centre of the grid, the more balanced is the learning style. If the data point falls near any of the far corners of the grid, the more heavily the subject relies on one learning style. Kolb (1985) labelled learners according to which quadrant they fell into: Accommodators are more active than reflective and more concrete than abstract; Convergers are more abstract than concrete; Divergers prefer concrete experience; and Assimilators are more abstract reflective. Only a minority of people tend to migrate to the extreme of one learning style or another, or in fact demonstrate no preferred learning style at all. Most people show a tendency to prefer one learning style over others, but they may also demonstrate all types of learning. Examples of learning style preference using the Kolb Learning-Style Type Grid are found in Figures 3.5 and 3.6. These examples are using the same raw Kolb LSI scores that were shown in Figures 3.3 and 3.4. The first example (Figure 3.5) is a person who demonstrates a strong Converger learning style preference, while the second example (Figure 3.6) is a person who demonstrates a weak Assimilator learning style preference.

There has not been a great deal of research on the learning styles of physical therapy students or practicing physical therapists using the Kolb LSI. This researcher could find only seven articles or studies that used the Kolb LSI either alone or with another instrument, and of those, the majority reported that physical therapy students fall into one of two learning style groups: Convergers or Assimilators (Barb et al. 1997; Daniel, 1999; Farina, 1997; Katz & Heimann, 1991; Pisarski, 1994; Wessel et al. 1999). Assimilators and Convergers prefer to learn a theoretical construct and then reflect upon it or experiment with it — abstract learning as opposed to concrete experience.

Figure 3.5 Kolb Learning Style Type Grid Example 1



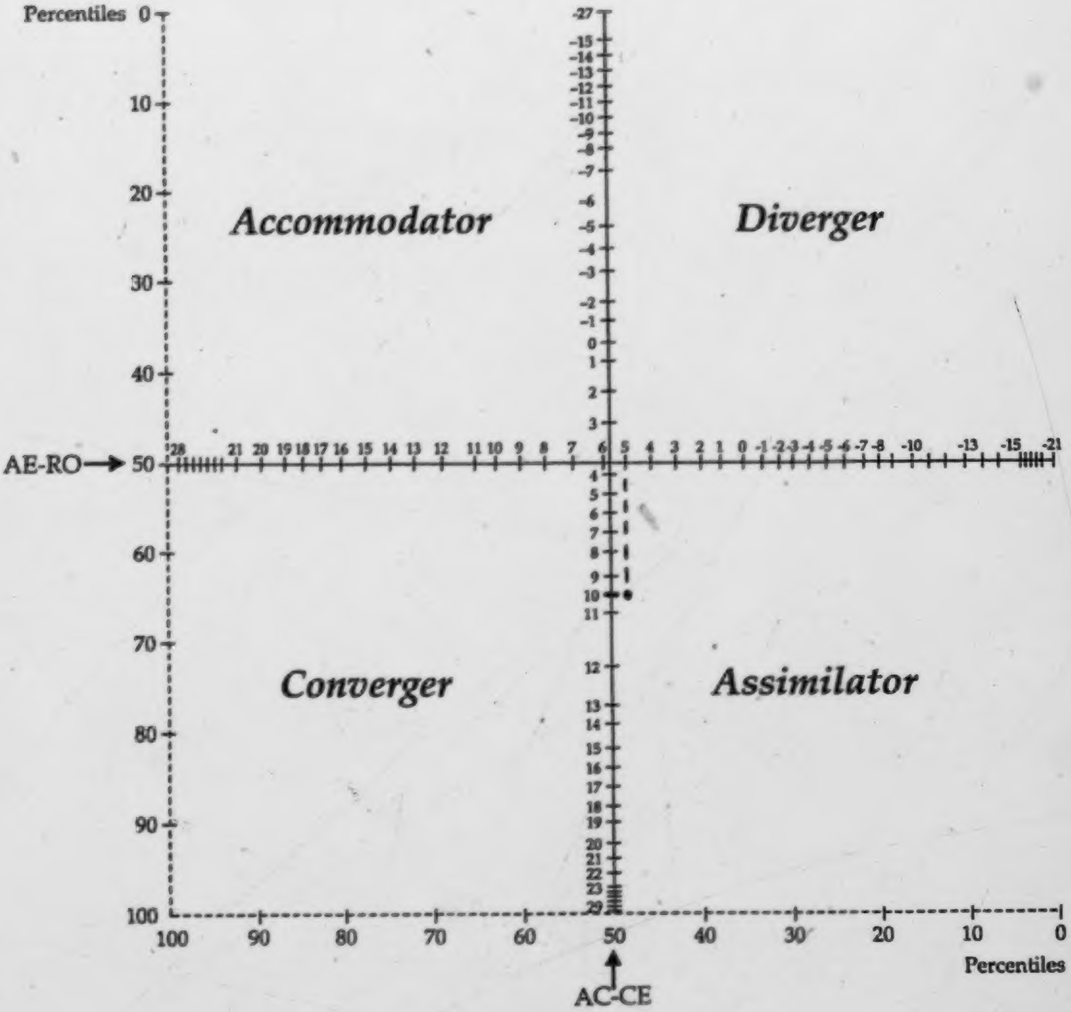
Raw scores: AE = 41; RO = 21; AC = 39; CE = 19

Combined scores: AE-RO = 41-21 = 20; AC-CE = 39-19 = 20

Combined scores are marked on the AE-RO and AC-CE grid lines

Learning style preference: Converger (strong: intersection point far into Converger quadrant)

Figure 3.6 Kolb Learning Style Grid Example 2


Percentiles
0
10
20
30
40
AE-RO → 50
60
70
80
90
100
Accommodator
Diverger
Converger
Assimilator
-27
-15
-14
-13
-12
-11
-10
-9
-8
-7
-6
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
29
28
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-10
-13
-15
-21
100
90
80
70
60
50
40
30
20
10
0
Percentiles
AC-CE

Raw scores: AE = 32; RO = 27; AC = 36; CE = 26

Combined scores: AE-RO = 32-27 = 5; AC-CE = 36-26 = 10

Combined scores are marked on the AE-RO and AC-CE grid lines

Learning style preference: Assimilator (weak: intersection point not too far into Assimilator quadrant)

Reliability and validity of the Kolb LSI

According to the LSI User's Guide (Smith & Kolb, 1986), the four basic scales and two combination scales of the instrument demonstrate good internal reliability. Sims, Veres, Watson and Buckner (1986) examined the revised LSI and found that the internal consistency of the revised LSI was substantially improved over the earlier (1979) version. Veres, Sims and Locklear (1991) further concluded that "the increased stability of the modified version argues against dismissal of the LSI as an instrument for the study of learning styles" (p. 143). Sims and Sims (1995) found that the LSI was psychometrically rated as strong in regard to reliability and fair in terms of validity. Willcoxson and Prosser (1996) examined the reliability and validity of the LSI using Arts and Science students in an Australian university. Their results indicated a high degree of reliability, with coefficient alpha reliabilities ranging from .81 to .87. The LSI also demonstrated satisfactory test-retest reliability (Cronbach's alpha .72). They found some evidence of validity where the four factors form two bipolar dimensions. However they did note that discipline variation was found between the Arts and Science students, with the predicted arrangement of factors found only for the Science students. Willcoxson and Prosser also suggested that further research might explore the possibility that preferred learning styles are influenced by cultural background. Katz (1986) found that adequate validity was found using the LSI in the United States on occupational therapy students. Ruble and Stout (1990) conducted a study to examine the reliability, construct validity, and response-set bias of the LSI. They suggest that while the internal consistency of the LSI has improved over the original, it appears that a columnar-scoring response set inflated estimates of reliability and construct validity.

Ferrell (1983) examined the Kolb LSI using factor analysis and supported its construct validity. However, Loo (1999) used confirmatory factor analysis to determine if the two proposed dimensions and four learning styles are clearly identified. Loo suggested that confirmatory factor analysis underscores concerns about factoring ipsative measures, however exploratory factor analysis using the four style scores supports the two bipolar dimensions. Loo goes on to state that "these criticisms of the factor structure do not take away from the usefulness of the LSI as a pedagogical tool" (p. 216).

Ipsative characteristics of the Kolb LSI

The Kolb LSI (1985) uses a 4-point forced-choice ipsative scale to generate a score on each of four learning abilities. Higher scores represent the individual's preferred learning approach. "Scores on a multi-scale measure are ipsative when raw scale scores sum to a constant for any individual. The ipsative score represents the relative strength of the construct compared with others in the set, rather than the absolute score" (Baron, 1996, p. 49). An ipsative measurement is one "where the score of an individual is dependent on his own score and/or other variables, but is independent of and not comparable to others" (Hicks, 1970, p. 167). Ipsative scores cannot be transformed into absolute scores and therefore, are appropriate only for individual comparisons

(Hicks, 1970). Cornwell and Manfredo (1994) explored Kolb's LSI and critically examined the ipsative scales used in the instrument. They stated that "an ipsative scale contains no information concerning the absolute or relative differences among individuals on a variable. Instead, the scale measures only relative differences or rank ordering of a set of variables for a single person" (p. 319). They proposed that Kolb's LSI was invalid since there was no support for the pairs of scores used by Kolb to define his bipolar dimensions. However in their study, Cornwell and Manfredo (1994) determined that a functional relationship does exist between the learning style types (i.e. Diverger, Assimilator, Converger, Accommodator) and the primary learning dimension (i.e. feeling, watching, thinking, doing) associated with these types. Therefore these classifications can be used and compared to the learning style types to determine the prevalence of the primary learning style.

Geiger and Boyle (1993) examined both the normative and ipsative versions of the LSI and found some rather interesting results. They developed a normative form of the revised LSI which scrambled the 48 original items, made them entirely independent and used a 1 to 7 Likert scoring format. The factor analysis of the standard ipsative LSI version produces results very similar to earlier construct validity research. They found, however, that in contrast to Kolb's theory, bipolar dimensions running from Abstract Conceptualization (AC) to Active Experimentation (AE) — or thinking to doing, and Concrete Experience (CE) to Reflective Observation (RO) — or feeling to watching. They also found a separate dimension for the Abstract Conceptualization abilities. Their analysis of the normative LSI version produced similar relative scale scores and sufficiently strong reliability results, but did not support the existence of any bipolar dimensions. They did, however, strongly support the four separate learning abilities underlying the inventory (Geiger & Boyle, 1993).

Pickworth and Schoeman (2000) examined the psychometric properties of the Kolb LSI and the Learning Style Questionnaire (LSQ) of Marshall and Merritt (1986). Because the LSQ is a normative instrument, Pickworth and Schoeman revised the Kolb LSI into a normative version (LSI Likert) for comparison. The results of their study demonstrated that the LSI-Likert was more successful than the LSQ in differentiating learning abilities and styles in the sample used (464 first year science and human science students). The four-factor solution for the LSI-Likert produced factors which represented the four learning abilities (Pickworth and Schoeman, 2000).

Data Analysis

The Kolb LSI uses a number of parameters to determine a learning style: learning style characteristics, combined scores, and learning style preference. Learning style characteristics (AC, AE, CE, RO) and combined scores (AC-CE, AE-RO) are numerical values that help mark the LSI scoring grid. Once the scores are plotted, a learning style preference (Accommodator, Assimilator, Converger, Diverger) can be identified depending upon where, on the grid, the scores fell.

Data analyses were then specifically selected to compare each of the Kolb LSI parameters. For continuous variables (AC, AE, CE, RO) and (AC-CE and AE-RO), analyses of variance were used. For categorical variables (Accommodator, Assimilator, Converger, Diverger), chi-square analyses were used.

Research question number 1: Were there differences in learning style among physical therapy students across different years of the PT program?

In order to determine if there were differences in PT student learning styles, mean AC, AE, CE and RO scores, and mean AC-CE and AE-RO combined scores were compared using six one-way analyses of variance. Wherever the alpha level (p = 0.05) was reached, Scheffé post-hoc analyses were done to determine differences for all paired comparisons. Learning style preference differences were analyzed by comparing the frequency of occurrence of each of the four Kolb LSI learning styles using a chi-square analysis. Chi-square is a nonparametric statistic used to determine if a distribution of observed frequencies differs from theoretical expected frequencies (Portney and Watkins, 2000).

Research question number 2: Were there differences in learning style of practicing physical therapists with different years of clinical experience?

In order to determine if there were differences in practicing PT learning styles, mean AC, AE, CE and RO scores, and mean AC-CE and AE-RO combined scores were compared using six one-way analyses of variance. Learning style preference differences among practicing PTs were compared using chi-square analysis.

Research question number 3: Were there differences in learning style between the physical therapy students (Groups A to D) and the practicing physical therapists (Groups E & F)?

In order to determine if there were differences in learning styles among physical therapy students and practicing physical therapists, mean AC, AE, CE and RO scores, and mean AC-CE and AE-RO scores were examined using six one-way analyses of variance. Wherever the alpha level ($p = 0.05$) was reached, Scheffé post-hoc analyses were done to determine differences for all paired comparisons. Learning style preference differences of the physical therapy students (Groups A-D) were compared to the learning style preferences of the practicing physical therapists (Groups E&F) using a chi-square analysis.

Research question number 4: Did the learning style of the physical therapy students (Groups A-D) change over time?

In order to determine if there were differences in the learning styles of physical therapy students over time, mean AC-CE and AE-RO combined scores were examined using two one-way analyses of variance with repeated measures for each group. Learning style preference differences were compared using a chi-square analysis.

Research question number 5: Did the learning style of practicing physical therapists (Group E) change from their last year in the physical therapy program to two years after graduation?

In order to determine if there were differences in the learning styles of practicing physical therapists over time, mean AC-CE and AE-RO combined scores were analyzed using two one-way analyses of variance with repeated measures for each group. Learning style preference differences were compared using a chi-square analysis.

Research question number 6: Were there differences in learning style between male and female students?

In order to determine if there were differences in learning styles among physical therapy students due to gender, mean AE-RO and AC-CE combined scores were examined using two one-way analyses of variance. Learning style preference differences were examined using a chi-square analysis.

Research question number 7: Were there differences in learning style between male and female practicing physical therapists?

In order to determine if there were differences in learning styles among practicing physical therapists due to gender, mean AE-RO and AC-CE combined scores were examined using two one-way analyses of variance. Learning style preference differences were examined using a chi-square analysis.

Summary

Chapter 3 described in detail the research design of this study. A description of the volunteer subject groups, data collection procedures, instrument, and planned data analyses were each discussed in detail. The results of the data collection and data analysis are presented in Chapter 4.

Chapter 4

RESULTS

Results of the data analyses are presented in this chapter. The first section describes demographic and the recruitment procedures for the six cohort groups. The second section describes the three sets of data that were obtained from this study: learning style characteristics, combined scores, and learning style. The final section of this chapter describes the analyses of the raw Kolb LSI data by relating the analyses to each of the seven research questions.

Demographics

Subjects

There were six cohort groups, comprising a total of 301 volunteer subjects for this study. There were four student groups with a total of 220 subjects (147 females, 73 males), and two practicing physical therapist groups, with a total of 81 subjects (63 females, 18 males). All subjects were recruited either in person (students) or by mail (practicing physical therapists). The mailing addresses for the practicing physical therapists were obtained from their student records or from the College of Physical Therapists of Alberta. Of the group of 255 students originally contacted, 220 agreed to participate in the study. The data of 35 students was not included for one of the following reasons: (a) they chose not to participate; (b) they did not complete the Kolb LSI the first time; (c) they were unable to complete the Kolb LSI a second time; or (d) they withdrew from the study. Of the group of 129 practicing physical therapists originally contacted, 81 agreed to participate in the study. The data of 48 practicing physical therapists was not included for one of the following reasons: (a) they chose not to participate; (b) they did not complete the Kolb LSI the first time; (c) they were unable to complete the Kolb LSI a second time (Group E); (d) they were unable to be reached via mail; or (e) they withdrew from the study.

The demographic data collected were: (a) year in the program for the four student groups at the two measurement times; (b) year in the program (Time 1) and two years after graduation (Time 2) [for Group E only]; (c) three years after graduation (Time 1) for group F; and (c) gender for all groups. These data are presented in Table 4.1.

Table 4.1

Demographic data of all groups

Group	**Status at Time 1**	**Status at Time 2**	**Gender**
A n = 63	PT 1 (September '97)	PT 1 (April '98)	female = 40 male = 23
B n = 52	PT 1 (January '97)	PT 2 (April '98)	female = 38 male = 14
C n = 54	PT 1 (January '96)	PT 3 (April '98)	female = 34 male = 20
D n = 51	PT 2 (September '95)	PT 4 (April '98)	female = 35 male = 16
E n = 41	PT 4 (September '95)	2 years post-grad (April '98)	female = 29 male = 12
F* n = 40	3 years post-grad (April '98)	▨	female = 34 male = 6

* Group F were tested only once: their first test time was Time 2 for all other groups.

Gender

The demographic data in this study relative to the gender of the physical therapy students indicates that 67% were female, and 33% were male. In the practicing physical therapist groups, 78% were female and 22% were male. These percentages are relatively consistent with current trends both in education and in clinical practice. Over the past few years, the number of male students in the Physical Therapy program at the University of Alberta has been around 25% (Admissions Committee Report, 2000). Both provincially and nationally, the number of males practicing physical therapy is normally close to 15%. In the 1999-2000 Annual Report of the College of Physical Therapists of Alberta, 18.5% and 81.5% of registered members were male and female, respectively. Nationally, male physical therapists comprise 15% of the membership of the Canadian Physiotherapy Association, while provincially, male physical therapists comprise 22% of the membership of the Alberta Physiotherapy Association (Canadian Physiotherapy Association Member Value Perception Survey, 2000).

Data sets

Three sets of data were collected in this study: learning style characteristics, combined scores, and learning style preference. Each of these data sets will be discussed individually with respect to what they are and how they can be used. In the final section of this chapter, these data will be used to answer the research questions.

Learning style characteristics

The Kolb Learning Style Inventory (LSI) measures a person's relative emphasis on each of the four modes of the learning process — concrete experience (CE), reflective observation (RO), abstract conceptualization (AC), and active experimentation (AE) (Kolb, 1984). Kolb's Learning Style Theory suggests that individuals have preferred orientations to the way in which they like to learn (Kolb, 1984). Kolb described this as a person's emphasis on each of the four modes of the learning process: concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking), and active experimentation (doing). These orientations or characteristics can then be combined to determine a preferred learning style. As a singular mode of learning, individuals may have a strong preference of one over the other three, or they could be relatively evenly preferred. However by themselves, these modes of learning do not make up the learning style. What they do show, however, are a person's tendencies towards particular preferred learning traits. Several authors (Barb et al. 1997; Cavanagh, Hogan & Ramgopal, 1995; Farina, 1997; Katz, 1990; Katz & Heimann, 1991; Kolb, 1984; Rakoczy & Money, 1995; Stafford, 1986) have examined learning styles in this way. It demonstrates which of the four Kolb LSI learning characteristics appears to be more predominant in an individual's learning style. Each of the four learning style characteristics can be described in a way that indicates a learner's preference. Raschick, Maypole and Day (1998) classified learning within the four primary Kolb dimensions as follows: (a) Concrete Experience, or learning through *experience*; (b) Reflective Observation or learning through *examining*; (c) Abstract Conceptualization or learning through *explaining*; and (d) Active Experimentation or learning through *applying*.

Combined scores

Combined scores give strength and direction for an individual's learning style preference on the concrete-abstract dimension and the active-reflective dimension. Kolb (1984) derived this theory from two fundamental adaptive processes that are in dialectical opposition: prehension and transformation. Therefore concrete experience is oriented against abstract conceptualization and reflective observation is oriented against active experimentation. Combined scores are determined by subtracting concrete experience (CE) from abstract conceptualization (AC) and subtracting reflective observation (RO) from active experimentation (AE). Kolb (1984) suggests that the combination scores indicate the extent to which the person emphasizes abstractness over concreteness (AC-CE) and the extent to which the person emphasizes action over reflection (AE-RO). The two values (AC-CE and AE-RO) are plotted on a grid to determine the learning style (Kolb, 1985). Examples of grid plots are found in Figures 3.5 and 3.6.

Learning style preference

An individual's preferred learning style is determined by taking the four Kolb LSI scores and combining them. The combined score numbers are plotted on a bipolar grid. The plotted scores result in a single point marked along the bipolar grid, or in one of the four quadrants. The further away from the crosshairs in the middle, the stronger the preference for the particular learning style. Kolb (1985) labelled learners according to which quadrant they fell into: Accommodators, Assimilators, Convergers, and Divergers. Accommodators are more active than reflective and more concrete than abstract; Convergers are more abstract than concrete; Divergers prefer concrete experience; and Assimilators are more abstract reflective. Only a minority of people tend to migrate to the extreme of one learning style or another, or in fact demonstrate no preferred learning style at all (the plotted scores would be in the centre of the crosshairs). Most people show a tendency to prefer one learning style over others, but they may also demonstrate all types of learning (Kolb, 1984).

Research questions

Research question 1: Were there differences in learning style among physical therapy students across different years of the Physical Therapy program?

There are three ways in which this question can be answered, using three sets of data: learning style characteristics, combined scores, and learning style preference. Each of these parameters was examined to determine if and where there were differences in learning styles across physical therapy student groups.

Learning Style Characteristics of Physical Therapy Students

The mean scores and standard deviations of the four Kolb LSI learning characteristics of Abstract Conceptualization (AC), Active Experimentation (AE), Concrete Experience (CE), and Reflective Observation (RO) obtained from the physical therapy students at Time 2 are shown in Table 4.2. and Figure 4.1. When each of the four learning style characteristic scores were compared with each other across all the student groups, there were no significant differences found. This demonstrated that all the student groups were consistent in their preference of learning style characteristics. It was found that the most preferred learning style characteristic was Active Experimentation (AE) and the least preferred learning style characteristic was Concrete Experience (CE), and that these were consistent within and across groups.

Table 4.2.

Comparison of Kolb LSI Means and Standard Deviations of AC, AE, CE and RO Scores of Physical Therapy Students Taken at Time 2.

Group		AC scores	AE scores	CE scores	RO scores
A (PT 1) n = 63	Mean S.D.	33.651 ±8.006	36.444 ±7.253	21.778 ±7.292	28.127 ±7.214
B (PT 2) n = 52	Mean S.D.	32.596 ±7.437	37.422 ±6.518	19.019 ±4.625	30.942 ±7.534
C (PT 3) n = 54	Mean S.D.	31.556 ±8.002	35.278 ±8.259	22.037 ±8.567	31.130 ±7.504
D (PT 4) n = 51	Mean S.D.	32.824 ±8.599	36.412 ±8.695	20.784 ±6.763	29.980 ±6.417

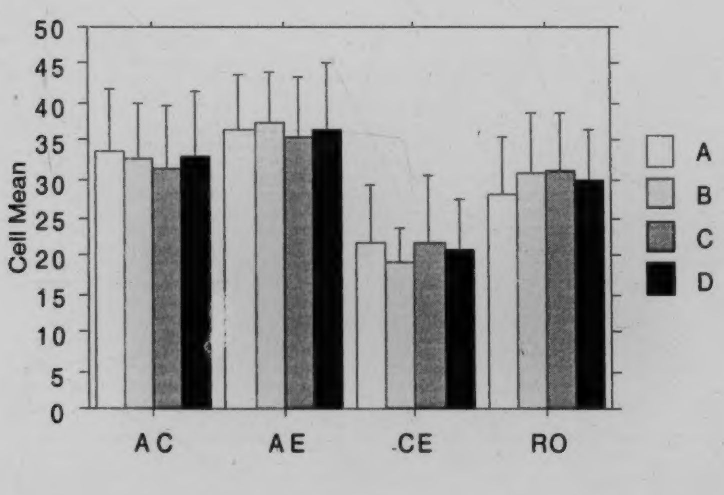


Figure 4.1. Means and standard deviations of AC, AE, CE and RO scores of physical therapy students (Groups A-D).

When all AC, AE, CE and RO scores were examined together, analysis of variance demonstrated a significant main effect (p <.001) among the students with respect to their learning style characteristic preferences. Scheffé post hoc analysis demonstrated that there were significant differences (p < .01) among all AC, AE, CE and RO scores. Active Experimentation (learning through applying) was preferred by significantly more students than any other learning style characteristic (p <.01). Abstract Conceptualization (learning through explaining) was the second most common learning style trait exhibited, followed by Reflective Observation (learning through examining). Concrete Experience (learning through experience) was preferred by significantly fewer students than any other learning style characteristic (p <.001). These data are in Table 4.3.

Table 4.3

Scheffé post hoc analysis of mean AC, AE, CE and RO scores of all physical therapy students.

	Mean Diff.	Crit. Diff.	P-Value	
AC, AE	-3.691	2.004	<.0001	S
AC, CE	11.736	2.004	<.0001	S
AC, RO	2.736	2.004	.0023	S
AE, CE	15.427	2.004	<.0001	S
AE, RO	6.427	2.004	<.0001	S
CE, RO	-9	2.004	<.0001	S

Combined scores for physical therapy students

The mean combined AC-CE and AE-RO scores and standard deviations of the combined scores of the physical therapy student cohort groups are found in Table 4.4 and shown in Figure 4.2. Several authors (Barb et al. 1997; Daniel, 1999; Farina, 1997; Katz & Heimann, 1991; Kolb, 1984; Wessel et al. 1999) suggest that physical therapy students demonstrate convergent learning styles and thus would be found more in the abstract-concrete dimension. Analysis of variance determined there were no significant differences in combined AC-CE or AE-RO scores across the student groups. This data suggests that although all the student groups were consistent in their range of AC-CE and AE-RO scores — being stronger in the abstract-concrete dimension than the active-reflective dimension — there were no significant differences in combined scores across years. There were no significant differences in AE-RO scores across the four physical therapy student groups, suggesting there were no significant differences in the emphasis of action over reflection in learning preference across the four student groups. The same holds true with the fact that there were no significant differences between AC-CE scores, indicating that there were no significant differences in the emphasis of abstractness over concreteness across the four student groups.

Table 4.4

Kolb LSI Combined AC-CE and AE-RO Score Means and Standard Deviations Taken at Time 2 of all Physical Therapy Students.

Group		**AC-CE scores**	**AE-RO scores**
A (PT 1) n = 63	Mean S.D.	11.889 ±12.622	8.317 ±11.605
B (PT 2) n = 52	Mean S.D.	13.577 ±9.860	6.500 ±11.930
C (PT 3) n = 54	Mean S.D.	9.519 ±14.172	4.418 ±13.230
D (PT 4) n = 51	Mean S.D.	12.078 ±12.967	6.431 ±12.811

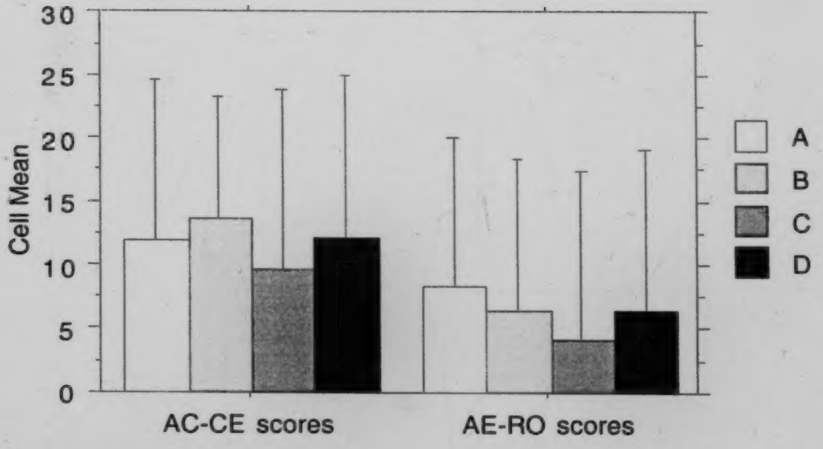


Figure 4.2. Means and standard deviations of AC-CE and AE-RO scores for all physical therapy students (Groups A-D).

Learning style preference of physical therapy students

Each of Kolb's four learning styles (Accommodator, Assimilator, Converger, and Diverger) was found in each of the four physical therapy student groups. This is demonstrated in Table 4.5 and Figure 4.3. In order to determine if there were significant differences in the number of each of the four Kolb learning styles within each of the four years of the physical therapy program, a chi-square analysis was used. Chi-square is a nonparametric statistic used to determine if a distribution of observed frequencies differs from theoretical expected frequencies (Portney and Watkins, 2000). Chi-square analysis revealed no significant differences in learning style preference among physical therapy students across different years of the program. This indicates that there were no significant differences in the numbers of each of the four learning styles when compared between first, second, third and fourth year student groups. The number of Accommodators, Assimilators, Convergers or Divergers did not differ significantly from one year to another. One learning style preference (Converger) was the most prevalent in groups A, B and D, while Assimilator was the most prevalent learning style preference in Group C. The least commonly found learning style preference for all groups was Diverger.

Table 4.5

Learning Style Preferences of Physical Therapy Students

	Learning Style			
Group	Accommodators	Assimilators	Convergers	Divergers
A (PT 1) n = 63	11	21	27	4
B (PT 2) n = 52	3	18	25	6
C (PT 3) n = 54	9	21	19	5
D (PT 4) n = 51	8	13	23	7

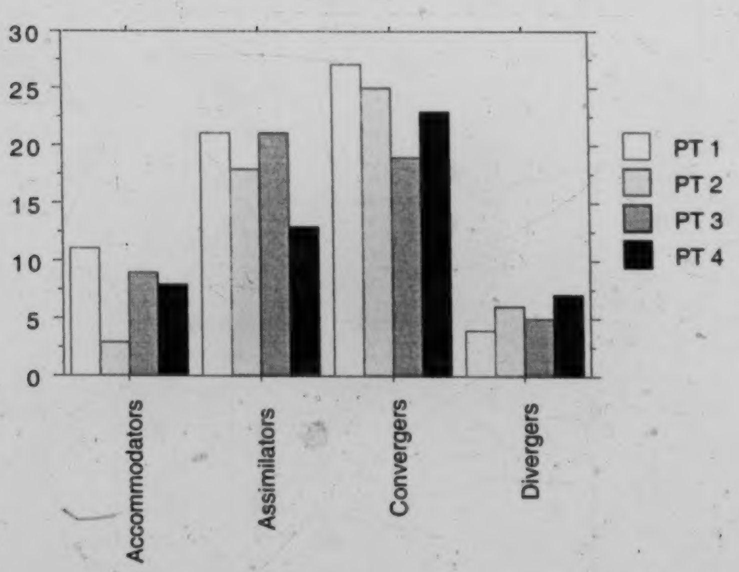


Figure 4.3. Number of physical therapy students in each of the four Kolb learning style categories.

When all physical therapy students' learning styles were examined together, analysis of variance did indicate there was a significant main effect with regard to learning style differences across groups ($p < .01$). There were significantly more Assimilators and Convergers than Accommodators and Divergers across the four years. Sheffé's post hoc analysis revealed there were significantly more Assimilators than Accommodators and Divergers, and significantly more Convergers than Accommodators and Divergers. There were no significant differences between the number of Convergers and Assimilators nor between Accommodators and Divergers. These results are found in Table 4.6. These data are consistent with literature that has examined the learning styles of physical therapy students. Research using the Kolb LSI on physical therapy students has indicated that the majority of these students tend to fall into one of two groups: Convergers and Assimilators (Barb et al. 1997; Daniel, 1999; Farina, 1997; Katz & Heimann, 1991; Pisarski, 1994; Wessel et al. 1999). Assimilators and Convergers prefer to learn a theoretical construct and then reflect upon it or experiment with it — abstract learning as opposed to concrete experience.

Table 4.6.

Scheffé post hoc analysis of learning styles of physical therapy students

	Mean Diff.	Crit. Diff.	P-Value	
Accomodator, Assimilator	-10.5	7.16	.0043	S
Accomodator, Converger	-15.75	7.16	.0001	S
Accomodator, Diverger	2.25	7.16	.7936	
Assimilator, Converger	-5.25	7.16	.1874	
Assimilator, Diverger	12.75	7.16	.0009	S
Converger, Diverger	18	7.16	<.0001	S

In summary, there were significant differences between the number of students in each of the four learning style categories, with Assimilators and Convergers being most prevalent. There were no significant differences in learning style preference between different years of physical therapy students in the Physical Therapy program.

Research question 2: Were there differences in learning style of practicing physical therapists with different years of clinical experience?

There are three ways in which this question can be answered,using three sets of data: learning style characteristics, combined scores, and learning style preference. Each of these parameters was examined to determine if and where there were differences in learning styles between the two practicing physical therapist groups. Group E had two years of clinical experience since graduation and Group F had three years of clinical experience since graduation.

Learning Style Characteristics of Practicing Physical Therapists

The mean scores and standard deviations of the four Kolb LSI learning modes of Abstract Conceptualization (AC), Active Experimentation (AE), Concrete Experience (CE), and Reflective Observation (RO) obtained from the practicing physical therapists are shown in Table 4.7 and Figure 4.4. Analysis of variance indicated there were no significant differences in AC, AE, CE or RO scores between the two groups of practicing physical therapists. There is not enough evidence to say that practicing physical therapists with two years of clinical experience (Group E) showed different learning style characteristics than those practicing physical therapists with three years of clinical experience (Group F).

Table 4.7.

Comparison of Kolb LSI Means and Standard Deviations of AC, AE, CE and RO Scores of Practicing Physical Therapists Taken at Time 2.

Group		**AC scores**	**AE scores**	**CE scores**	**RO scores**
E n = 41	Mean S.D.	34.683 ±8.601	34.756 ±7.752	22.171 ±7.781	28.390 ±6.873
F n = 40	Mean S.D.	34.950 ±7.103	35.625 ±7.499	20.200 ±6.418	29.225 ±8.754

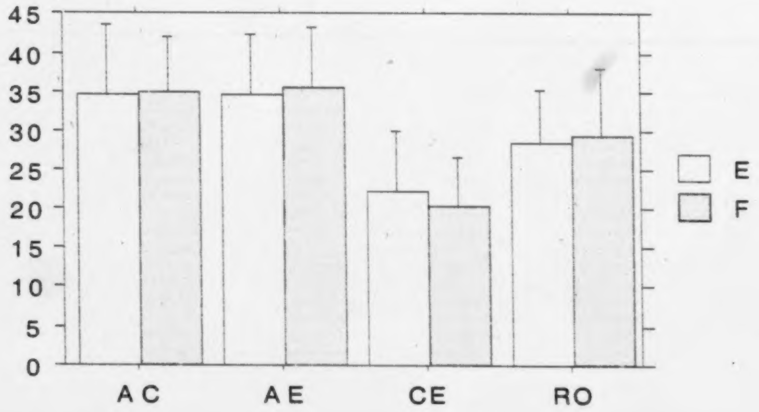


Figure 4.4. Means and standard deviations of AC, AE, CE and RO scores of practicing physical therapists (Groups E & F).

Combined scores of practicing physical therapists

The mean combined AC-CE and AE-RO scores and standard deviations of the combined scores of the practicing physical therapist cohort groups are found in Table 4.8 and shown in Figure 4.5. There were no significant differences between AC-CE scores or AE-RO scores between the two practicing physical therapy groups.

Table 4.8.

Kolb LSI Combined AC-CE and AE-RO Score Means and Standard Deviations Taken at Time 2 of all Practicing Physical Therapists.

Group		**AC-CE scores**	**AE-RO scores**
E n = 41	Mean S.D.	12.512 ±13.172	6.366 ±10.915
F n = 40	Mean S.D.	14.750 ±10.987	6.400 ±14.254

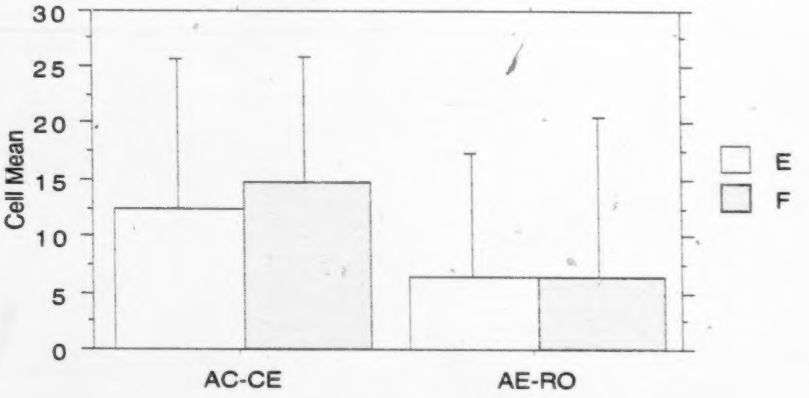


Figure 4.5. Means and standard deviations of AC-CE and AE-RO scores for all practicing physical therapists (Groups E & F).

Learning style preference of practicing physical therapists

Within the practicing physical therapist groups, each of Kolb's four learning styles was identified. This is demonstrated in Table 4.9 and Figure 4.6. Chi-square analysis determined there were no significant differences in the number of each of the four Kolb learning styles among the two groups. When each group was compared to the other, one learning style preference (Converger) was most prevalent. The least commonly found learning style preference (Diverger) was the same for both groups.

Table 4.9

Learning style preferences of practicing physical therapists

Group	**Learning Style**			
	Accommodator	Assimilator	Converger	Diverger
E (n = 41)	8	12	18	3
F (n = 40)	6	14	19	1
Total (n = 81)	14	26	37	4

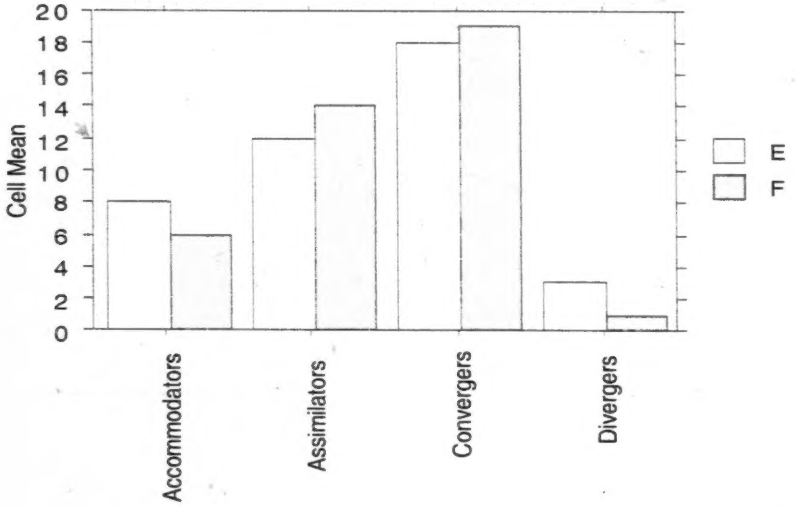


Figure 4.6. Number of practicing physical therapists (Groups E & F) in each of the four Kolb learning style categories.

When all practicing physical therapist's learning styles were examined together, analysis of variance did indicate a significant main effect with regard to learning style differences within each physical therapy group (p < .01). There were significantly more Assimilators and Convergers than Accommodators and Divergers between the two groups of practicing physical therapists. Sheffé's post hoc analysis revealed there were significantly more Assimilators than Accommodators (p < .05) and Divergers (p < .01), and significantly more Convergers than Accommodators (p < .01) and Divergers (p < .01). There were no significant differences between the number of Convergers and Assimilators nor between Accommodators and Divergers. These results are found in Table 4.10.

Table 4.10

Scheffé post hoc analysis of learning styles of all practicing physical therapists

	Mean Diff.	Crit. Diff.	P-Value	
Accommodators, Assimilators	-6	6	.0416	S
Accommodators, Convergers	-12	6	.0041	S
Accommodators, Divergers	5	6	.0741	
Assimilators, Convergers	-6	6	.0551	
Assimilators, Divergers	11	6	.0048	S
Convergers, Divergers	16	6	.0010	S

Only two studies could be identified that used the Kolb LSI on practicing physical therapists, therefore it is difficult to determine if the current results are consistent with the literature. Katz and Heimann (1991) found that physical therapists were mostly Assimilators, and they had a small group size of only 23. Bennet, in an unpublished thesis (cited in Kolb, 1984), found physical therapists to be mostly Accommodators (no group size mentioned). Kolb (1984) suggests that professions with a technical or scientific base have people with convergent learning styles; he further states that half of practitioners and students tested were also Convergers. In the current study, both the physical therapy student groups and practicing physical therapist groups were predominantly Convergers.

In summary, there were no differences in learning style preference among practicing physical therapists with different years of clinical experience.

Research question 3: Were there differences in learning style between the physical therapy students (Groups A to D) and the practicing physical therapists (Groups E & F)?

As with research questions 1 and 2, this question can be answered by examining three different sets of data: learning style characteristics, combined scores, and learning style preference. The total student group numbered 220 while the practicing physical therapist group numbered 81.

Learning style characteristics

When the learning style characteristics (AC, AE, CE and RO) of the physical therapy students were compared to the learning style characteristics of the practicing physical therapists (Figure 4.7), the only significant difference found was between Abstract Conceptualization (AC) scores ($p < .05$). The students' AC mean was significantly higher than the practicing physical therapists' AC mean, which perhaps suggests that the students may have preferred learning through explaining more than the practicing therapists. It may also be due to the fact that because they are students, they are used to having things explained to them more regularly in the classroom or laboratory.

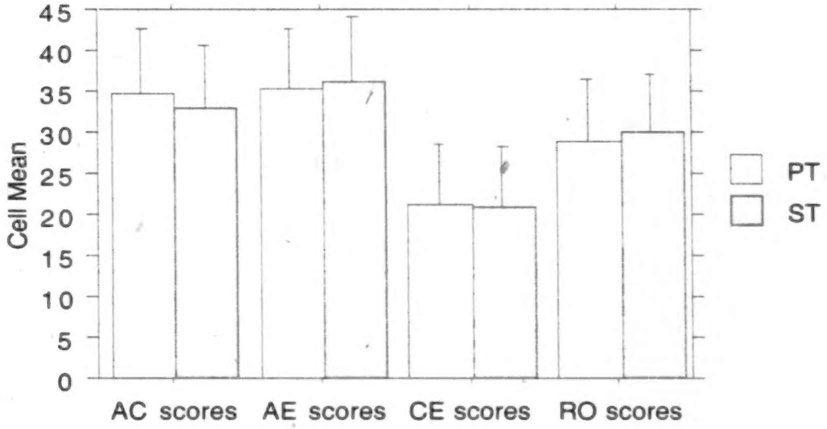


Figure 4.7. Comparison of means and standard deviations of AC, AE, CE and RO scores of all physical therapy students (ST) and all practicing physical therapists (PT).

Combined scores

When the combined scores of AC-CE and AE-RO were compared between the physical therapy students and practicing physical therapists, no significant differences were found. The data of the combined AC-CE and AE-RO scores for physical therapy students and practicing physical therapists suggests that both groups were consistent in their range of AC-CE and AE-RO scores. The data is presented in Figure 4.8. Both groups were stronger in the abstract-concrete dimension than in the active-reflective dimension. Several authors (Barb et al. 1997; Daniel, 1999; Farina, 1997; Katz & Heimann, 1991; Pisarski, 1994; Wessel et al. 1999) suggest that physical therapy students demonstrate convergent learning styles and thus would be found more in the abstract-concrete dimension. The same has not been reported about practicing physical therapists, either due to the lack of studies or the lack of reporting the comparisons of combined scores.

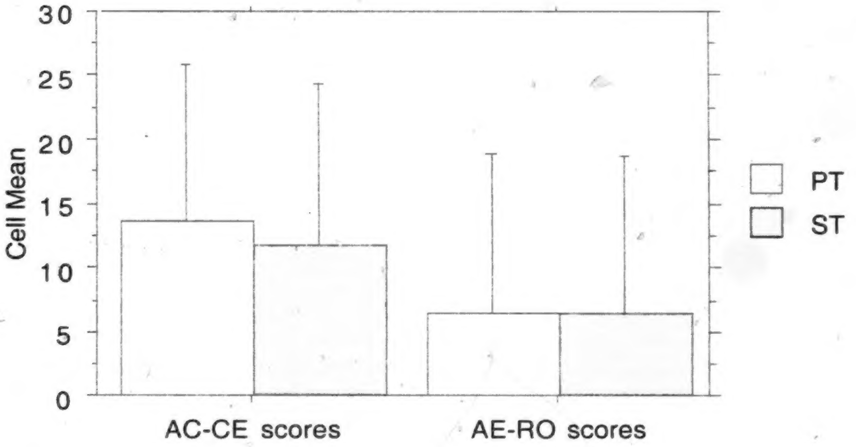


Figure 4.8. Comparison of means and standard deviations of combined AC-CE and AE-RO scores of physical therapy students (ST) and practicing physical therapists (PT).

Learning style preference

When the learning styles of all of the physical therapy students and all of the practicing physical therapists were compared, chi-square analysis indicated there were no significant differences in the observed frequencies of each of the Kolb LSI learning styles.

In summary, there were no differences in learning style between the physical therapy students and the practicing physical therapists.

Research question 4: Did the learning style of the physical therapy students (Groups A-D) change over time?

This question can also be answered by examining the three sets of data: learning style characteristics, combined scores, and learning style preference.

Learning style characteristics

To determine if there was any change over time, the four learning style characteristics of Abstract Conceptualization (AC), Active Experimentation (AE), Concrete Experience (CE), and Reflective Observation (RO) of the four physical therapy student groups were examined using one-way analyses of variance with repeated measures. There were no significant differences found between Time 1 and Time 2 measures in any of the learning style characteristics. An example of a typical result set (AC scores) is shown in Figure 4.9.

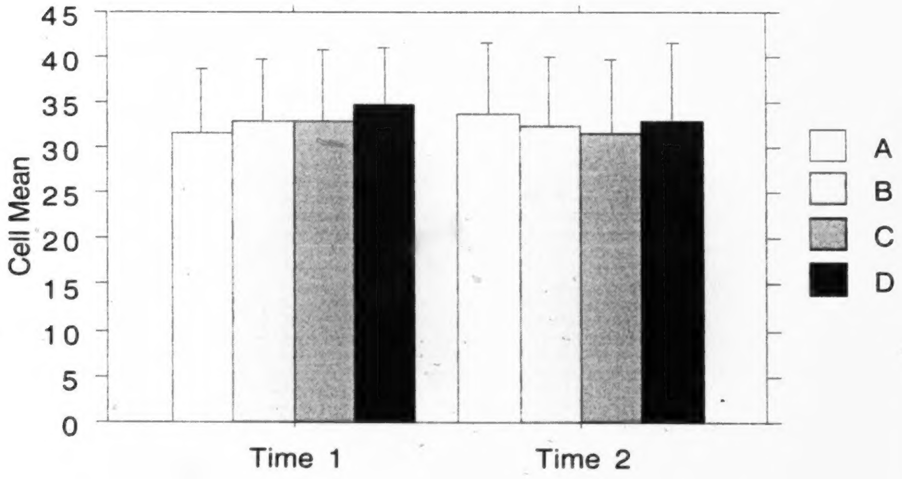


Figure 4.9. Means and standard deviations of repeat ANOVA AC scores of all physical therapy students (Groups A-D).

Combined scores

The combined scores of AC-CE and AE-RO of all physical therapy student groups (A-D) were analyzed using one-way analyses of variance with repeated measures. There were no significant differences found between Time 1 and Time 2 measures in the combined scores. These results are illustrated in Figures 4.10 and 4.11.

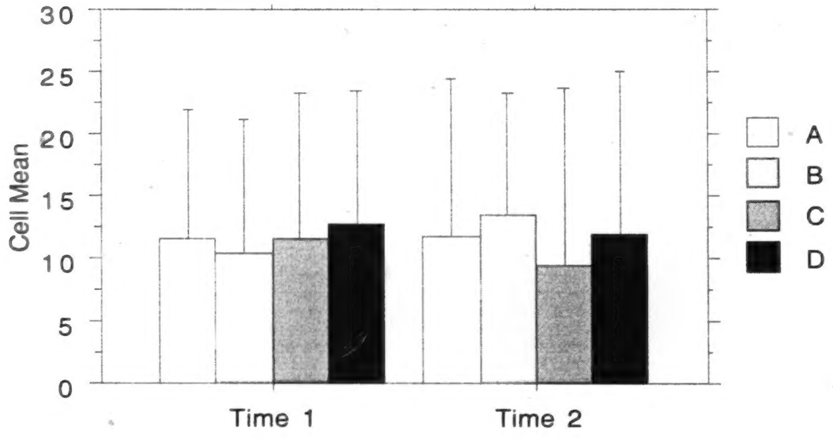


Figure 4.10. Means and standard deviations of repeat ANOVA combined AC-CE scores of all physical therapy students (Groups A-D).

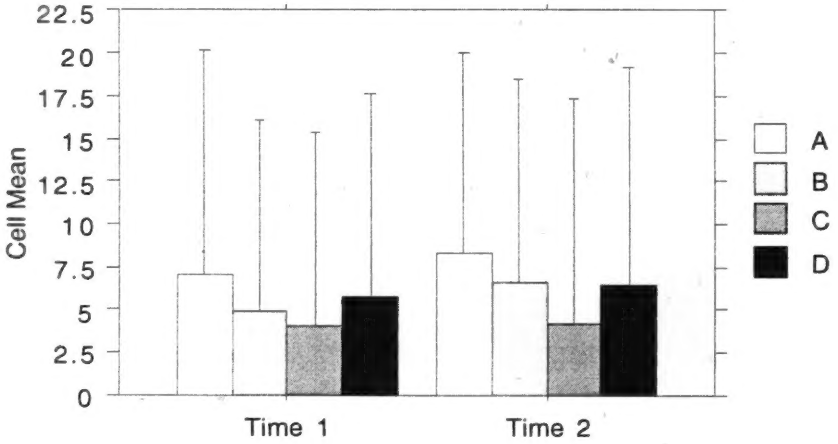


Figure 4.11. Means and standard deviations of repeat ANOVA combined AE-RO scores of all physical therapy students (Groups A-D).

Learning style preference

The learning style preference of all physical therapy students was compared from Time 1 to Time 2 using a chi-square analysis, which revealed there were no significant changes in physical therapy students' learning style preference over time. While several individual students did change their learning style preference from Time 1 to Time 2 as measured by the Kolb LSI, there were no significant differences found when all the student groups were compared. A frequency table demonstrating the learning style preferences of Groups A-D over time is found in Table 4.11.

Table 4.11

Observed Frequencies of Learning Style Preference of Physical Therapy Students at Time 1 and Time 2.

Student group

	PT 1	(A)	PT 2	(B)	PT 3	(C)	PT 4	(D)	**Totals**
Learning style	T1	T2	T1	T2	T1	T2	T1	T2	T1/T2
Accommodators	10	11	4	3	8	9	5	8	27/31
Assimilators	24	21	22	18	22	21	20	13	88/73
Convergers	26	27	19	25	18	19	22	23	85/94
Divergers	3	4	7	6	6	5	4	7	20/22
Totals	63	63	52	52	54	54	51	51	220/220

T1 = Time 1; T2 = Time 2

Research question 5: Did the learning style of practicing physical therapists (Group E) change from their last year in the physical therapy program to two years after graduation?

As with previous questions, three sets of data can be examined to determine if there were differences in the learning style of Group E.

Learning style characteristics

To determine if there was any change over time, the four learning style characteristics of Abstract Conceptualization (AC), Active Experimentation (AE), Concrete Experience (CE), and Reflective Observation (RO) of practicing physical therapists from Group E were examined using one-way analyses of variance with repeated measures. There were no significant differences found between Time 1 and Time 2 measures in any of the learning style characteristics.

Combined scores

One-way analyses of variance (ANOVA) with repeated measures were used to determine if there were any differences in combined scores from Time 1 to Time 2 for Group E. There were no significant differences in the AE-RO scores, however the ANOVA revealed a significant difference ($p < .05$) in the AC-CE scores (see Figure 4.12). The AC-CE values increased from Time 1 to Time 2, which demonstrated that more people in Group E emphasized abstractness over concreteness in their second Kolb test than in their first. It may be that this group changed the way they learned because they were no longer students.

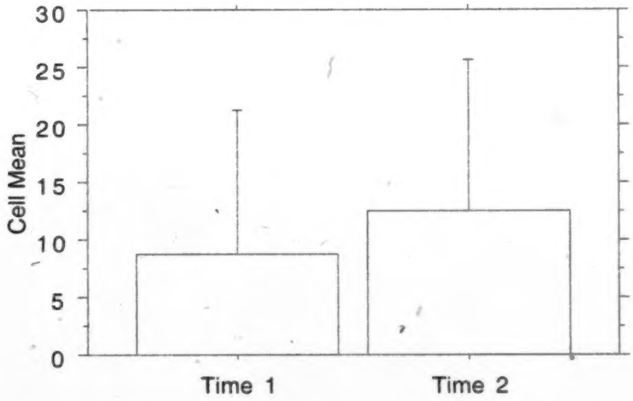


Figure 4.12 Means and standard deviations of AC-CE scores of Group E taken at Time 1 and Time 2. ($p < .05$)

Learning style preference

The learning style preferences of Group E were compared from Time 1 to Time 2 using a chi-square analysis, which revealed there were no significant changes in learning style preference over time. While a few individuals did change their learning style preference from Time 1 to Time 2 as measured by the Kolb LSI, there were no significant differences found when the whole group was compared. This indicates that from measurement Time 1 when they were senior physical therapy students until measurement time 2 when they were practicing physical therapists with 2 years of experience, their learning style preference did not change. A frequency table demonstrating the learning style preferences of Group E over time is found in Table 4.12.

Table 4.12

Observed Frequencies of Learning Style Preference of Group E at Time 1 and Time 2.

Learning Style	Time 1	Time 2
Accommodators	8	8
Assimilators	12	12
Convergers	16	18
Divergers	5	3

Research question 6: Were there differences in learning style between female and male physical therapy students?

Three sets of data can be examined to determine if there were differences in learning style between female and male physical therapy students.

Learning style characteristics

The four learning style characteristics of Abstract Conceptualization (AC), Active Experimentation (AE), Concrete Experience (CE), and Reflective Observation (RO) of all female and male physical therapy students were examined using one-way analyses of variance. There were no significant differences found in three of the learning style characteristics: AE, CE and RO. There were significant differences ($p < .05$) found in the Abstract Conceptualization (AC) scores, where the males had a higher mean score than the females. This is demonstrated in Figure 4.13. Kolb (1984) suggests that an orientation towards Abstract Conceptualization focuses on using logic, ideas and concepts. It emphasizes thinking as opposed to feeling; a concern with building general theories as opposed to intuitively understanding unique, specific ideas; a scientific as opposed to artistic approach to problems.

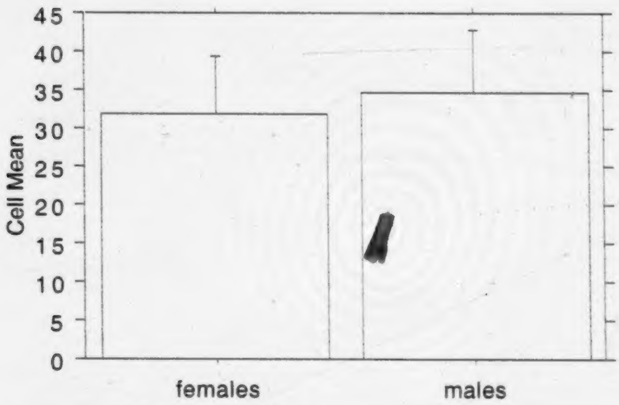


Figure 4.13. Means and standard deviations of Abstract Conceptualization (AC) scores of female and male physical therapy students. ($p < .05$)

Combined scores

One-way analyses of variance revealed there were no significant differences in the AC-CE or AE-RO combined scores of female and male physical therapy students.

Learning style preference

The learning style preferences of female physical therapy students were compared to the learning style preferences of male physical therapy students using a chi-square analysis, and there were no significant differences found. While there were large differences in the number of female versus male students (147 and 73, respectively), the chi-square analysis examined both the observed frequencies and also the percentages of each of the learning style preferences for each gender. This indicated that the percentage of female Accommodators, Assimilators, Convergers and Divergers was not significantly different from the percentage of male Accommodators, Assimilators, Convergers and Divergers. This is demonstrated in Table 4.13.

Table 4.13

Observed Frequencies of Learning Style Preferences of Female and Male Physical Therapy Students.

	Females	**Males**	
Learning style	Frequency/n/(%)	Frequency/n/(%)	Total: M & F/n/(%)
Accommodators	21/147 (14.268)	10/73 (13.699)	31/220 (14.091)
Assimilators	51/ 47 (34.694)	22/73 (30.137)	73/220 (33.182)
Convergers	60/147 (40.816)	34/73 (46.575)	94/220 (42.727)
Divergers	15/147 (10.204)	7/73 (9.589)	22/220 (10.000)
Totals	147/147 (100)	73/73 (100)	220/220 (100)

Research question 7: Were there differences in learning style between male and female practicing physical therapists?

Three sets of data can be examined to determine if there were differences in learning style between male and female practicing physical therapists.

Learning style characteristics

The four learning style characteristics of Abstract Conceptualization (AC), Active Experimentation (AE), Concrete Experience (CE), and Reflective Observation (RO) of all male and female practicing physical therapists were examined using one-way analyses of variance. There were no significant differences found among any of the learning style characteristics between male and female practicing physical therapists.

Combined scores

One-way analyses of variance revealed there were no significant differences in the AC-CE or AE-RO combined scores of male and female practicing physical therapists.

Learning style preference

The learning style preference of the female and male practicing physical therapists in this study were predominantly Convergers (37/81 [45.6 %]) and Assimilators (26/81 [32 %]). Significant differences ($p < .05$) were found in learning style preferences between female and male practicing physical therapists using a chi-square analysis. The differences between male and female practicing physical therapists were evident with all learning styles. While there was a large difference in the number of female versus male practicing physical therapists (63 and 18, respectively), chi-square analysis examined both the observed frequencies and also the percentages of each of the learning style preferences for each gender. This indicated that the percentage of female Accommodators, Assimilators and Convergers was significantly different from the percentage of male Accommodators, Assimilators and Convergers. There were no male Divergers while there were four female Divergers. The number of female Assimilators and Convergers were equally distributed and comprised the largest percentage of the female total at 36.5 percent. Males however, were significantly more common as Convergers at 77 percent of their total. The next highest male learning style preference were Assimilators at 16 percent of the total. The chi-square frequency table is found in Table 4.14.

Unlike the physical therapy students who demonstrated relatively equal percentages of females and males in each of the four learning style preferences, practicing physical therapists' learning style preferences were distributed unequally. Among the males in particular, this may be due to the small number of respondents (n = 18).

Table 4.14

Observed Frequencies of Learning Style Preferences of Female and Male Practicing Physical Therapists.

	Females	**Males**	
Learning style	Frequency/n/(%)	Frequency/n/(%)	Total: M & F/n/(%)
Accommodators*	13/63(20.635)	1/18(5.556)	14/81(17.284)
Assimilators*	23/63 (36.508)	3/18(16.667)	26/81(32.099)
Convergers*	23/63 (36.508)	14/18(77.778)	37/81(45.679)
Divergers	4/63(6.349)	0/18 (0.000)	4/18(4.938)
Totals	63/63(100)	18/18 (100)	81/81(100)

* Denotes significant difference between males and females

Summary

In summary, there were some interesting results revealed after the variety of statistical analyses were completed. There were no real surprises. There were no significant differences in learning styles among physical therapy students across different years of the Physical Therapy program at the University of Alberta. There were however, significantly more Convergers and Assimilators than Accommodators or Divergers. Within the practicing physical therapist groups, there were no significant differences in learning style, and as with the students, Convergers and Assimilators were found to be the most prevalent learning style preference. When the students were compared to the practicing therapists, again there were no significant differences found in preferred learning style. The students did demonstrate a preference for Abstract

Conceptualization as a learning mode compared to the therapists, which may suggest that students prefer to learn through explaining while the therapists preferred to learn through doing.

Both the student groups and the practicing therapist groups were examined to determine whether their preferred learning style changed over time. There were no significant changes for either the students or the therapists. The final research question dealt with the issue of gender, and it was found that there were no significant differences in the preferred learning styles of female versus male students. Both female and male physical therapy students were predominantly Convergers and Assimilators. There were significant differences within the practicing physical therapist group with regard to preferred learning style. The female therapists were equally split between Convergers and Assimilators, while the male therapists were mostly Convergers. It must be taken into consideration however, that the total number of males (18) was very low when compared to the total number females (63) in the practicing physical therapist groups.

Chapter 5

DISCUSSION, CONCLUSIONS AND IMPLICATIONS

This chapter provides a discussion of the results of the study, draws conclusions from the discussion, and states implications of this research.

Summary of the study

The rationale for this study arose from the fact that there was not a great deal of information about the learning styles of physical therapy students or practicing physical therapists. Indeed, the work by Wessel et al. (1999) was the first study published about the learning styles of Canadian physical therapy students. There is no published information about the learning styles of practicing physical therapists in Canada. The primary intent of this study was to examine the preferred learning styles of physical therapy students and practicing physical therapists and determine if there were relationships between learning styles and year in the PT program, years since graduation, students and practicing therapists, learning styles and time, and gender. The information from this study may be used in two ways: 1) to provide instructors with information about the learning styles of their students in order that they might use a variety of teaching strategies to facilitate learning for students with different learning styles, and 2) to provide the program in Physical Therapy at the University of Alberta with information about the potential of using the learning style preference of prospective students as part of the admission procedures for entry into Physical Therapy.

The objectives of this study were: (a) to determine the learning style preferences of students in the Physical Therapy program at the University of Alberta, and to examine if their learning style preferences changed over time during their program; (b) to determine the learning style preferences of practicing physical therapists and examine if their learning style preferences differ from physical therapy students; and (c) to determine if there are gender differences in the learning style preferences of physical therapy students and practicing physical therapists. Demographic data and learning style preferences were collected from 220 physical therapy students and 81 practicing physical therapists. The students were volunteers recruited from the Physical Therapy Program at the University of Alberta and represented each of the four years of the program (63 first years; 52 second years; 54 third years; 51 fourth years). The practicing physical therapists were volunteers recruited from two Physical Therapy classes who had previously graduated from the University of Alberta (41 from the class of 1996 and 40 from the class of 1995).

The demographic data gathered were gender and year in the program. The Physical Therapy program at the University of Alberta is a four year undergraduate program, leading to the degree of Bachelor of Science in Physical Therapy.

The learning style data were obtained using the Learning Style Inventory (LSI) of David Kolb (1984). This is an ipsative scoring instrument that requires the subject to respond by rank ordering learning preferences in response to 12 statements. The LSI measures a person's relative emphasis on each of the four modes of the learning process (Kolb, 1984). The LSI scores determine four learning style characteristics: Abstract Conceptualization (AC) or learning through *explaining*, Active Experimentation (AE) or learning through *applying*, Concrete Experience (CE) or learning through *experience*, and Reflective Observation (RO) or learning through *examining.* These scores provide the subjects with an idea of how they prefer to learn. These scores are then combined in order to plot them on the Kolb LSI grid. Combined scores give strength and direction for an individual's learning style preference on the concrete-abstract dimension and the active-reflective dimension. Combined scores are determined by subtracting concrete experience (CE) from abstract conceptualization (AC) and subtracting reflective observation (RO) from active experimentation (AE). Kolb (1984) suggests that the combination scores indicate the extent to which the person emphasizes abstractness over concreteness (AC-CE) and the extent to which the person emphasizes action over reflection (AE-RO). When the two combined scores AC-CE and AE-RO are then plotted on the Kolb LSI grid, the point of intersection of these two scores [data point] determines to which one of the four learning styles the subject belongs. The closer the data point is to the centre of the grid, the more balanced is the learning style. If the data point falls near any of the far corners of the grid, the more heavily the subject relies on one learning style. The four learning styles are Accommodator, Assimilator, Converger and Diverger.

Discussion

Learning style characteristics

Kolb's learning style theory suggests that individuals have preferred orientations to the way in which they like to learn (Kolb, 1984). He described this as a person's emphasis on each of the four modes of the learning process: concrete experience (feeling), reflective observation (watching), abstract conceptualization (thinking), and active experimentation (doing). The four learning style characteristics help determine the preferred learning style. While each of these four aspects is essential to learning when taken by itself, each can also be individually or culturally understood to represent a preferred learning style (Anderson & Adams, 1992).

The current study revealed that the physical therapy students' learning style characteristics were consistently similar within and across years in the PT program. For the PT students, the most preferred learning style characteristic was Active Experimentation (AE), while the least preferred characteristic was Concrete Experience (CE). The students preferred to take an active, practical approach to testing possible solutions. They preferred a systematic approach to problems rather than relying more on feelings to deal with everyday situations.

From the results in this study it can be concluded that physical therapy students prefer to do the work — to learn actively — rather than to have feelings and reflect on the work they do and the way they learn. While physical therapy is a hands-on profession, it is interesting to see that what they learn from experience and feeling is the least prominent of their learning style characteristics. Physical therapy is more than the "laying on of hands" — it is about caring and feeling and treating the patient as a whole, not simply the injured parts. Physical therapy students are exposed to a variety of clinical experiences where they are directly involved in patient assessment and treatment. In this study, student clinical placement experiences ranged from 1 to 30 weeks. The first year students had only one week of clinical observation. Second year students also had only one week of clinical observation — their five week clinical placement did not commence until May (the LSI was administered in April). Third year students had between 5 and 15 weeks of clinical experience, and fourth year students had between 20 and 31 weeks of clinical experience. While the clinical component of the PT program consists of a total of 31 weeks of clinical experience, the amount each student had at the time the LSI was administered was quite variable.

It appears from the LSI results that the students did not perceive that their clinical experiences formed a major part of their preferred method of learning. Across all student groups, the CE scores were the lowest. This may be due to their perceived lack of experience. Perhaps the students did not use what clinical experience they had when they completed the LSI. They may have completed the LSI thinking only of classroom and clinical skills lab teaching and learning experiences. It may also have been due to the fact that there were few opportunities for the students to reflect on their clinical experiences with classmates and instructors. When they return from their clinical placements, there is little opportunity for them to formally discuss among themselves and with their instructors how things went in their placements. Perhaps with more opportunity to discuss what they learned in their clinical placements, students would become more reflective and develop a stronger sense of feeling about their experiences.

Students who demonstrate a strong active experimentation focus learn well through simulation, case studies, laboratory, field work, projects and homework (Svinicki & Dixon, 1987). Students in our physical therapy program use these methods of learning regularly because they are among the methods instructors use to teach. Are we, therefore, as instructors unknowingly catering to their particular learning needs by utilizing these teaching strategies? Are we inhibiting the other learning characteristics by not utilizing more appropriate teaching strategies for students who do not use active experimentation as a primary method of learning? Physical therapy students are primarily concerned with **how** to do a particular assessment or treatment, whereas many of us are trying very hard to teach them **why** they would perform a particular assessment or treatment. This is due, in part, to the fact that evaluation drives learning. Students tend to be examined and evaluated more on the how than the why. During their clinical placements, they are also expected to demonstrate to their clinical supervisors how to perform an assessment or treatment. This is not to say that why something is taught or done in clinical fieldwork is not important, but rather it is not evaluated as much as it should be for students to appreciate the value of why it is learned.

The learning style characteristics of the two groups of practicing physical therapists were similar to each other as well as being similar to the physical therapy students. The AE and AC scores of the practicing physical therapists were nearly identical, meaning they put as much emphasis on thinking and explaining as they placed on doing as keys to their learning. This makes sense from the perspective of them having two or three years of post-graduation clinical practice experience. As practicing clinicians, they can afford to take the time to review and reflect on a particular treatment approach or intervention before using or modifying the treatment with a patient. Reflection and discussion among clinicians is a form of peer feedback. Students, on the other hand, are more often expected to demonstrate their knowledge and skills because that is what is most often evaluated by instructors. They are not often evaluated on their ability to reflect, and thus are not encouraged to reflect and communicate with their peers as much as they ought to be.

The lowest learning style characteristic score for the practicing physical therapists was also Concrete Experience (CE). It is somewhat surprising that these clinicians would view their experience as the least important aspect of their learning. With the experience gained working, it could be anticipated that learning might become more rounded, and less focused on learning "how to do it right". However it must be mentioned that students who graduate from physical therapy programs in Canada must pass a national competency examination before they can be granted a licence to practice. It stands to reason that once these two groups graduated in 1995 and 1996 respectively, they were still studying in order to pass the national competency exam, and were more than likely still trying to learn to do it right and did not spend a great deal of time thinking, feeling and reflecting about how they were learning.

Combined scores

Kolb (1984) states that all of the learning strategies taken separately have an incompleteness about them, and that more powerful and adaptive forms of learning emerge when these strategies are used in combination. Combined scores give strength and direction for an individual's learning style preference on the concrete-abstract dimension and the active-reflective dimension. Therefore concrete experience is oriented against abstract conceptualization and reflective observation is oriented against active experimentation. Combined scores are determined by subtracting concrete experience (CE) from abstract conceptualization (AC) and subtracting reflective observation (RO) from active experimentation (AE). Kolb (1984) suggests that the combination scores indicate the extent to which the person emphasizes abstractness over concreteness (AC-CE) and the extent to which the person emphasizes action over reflection (AE-RO). Anderson and Adams (1992) suggest that these characteristics are bipolar intersecting dimensions, representing on the one hand how we take in or perceive information (the vertical axis, on a continuum from concrete to abstract) and, on the other hand, how we process or transform what we take in (the horizontal axis, on a continuum from reflective observation across to active experimentation). This grid is shown in Figure 2.2.

The combined scores of the physical therapy students in this study were found to be consistent across the four years. Collectively, the students had a stronger preference for thinking over feeling and a slightly stronger preference for doing over watching. The fact that these students preferred thinking over feeling is an interesting finding. As health care practitioners, physical therapists must develop an ethic of care in their profession. They must develop a sense of understanding the patient as a whole, and learn to focus on the big picture, not just the patient's impairment or disability. It is interesting, therefore, to see that action and doing was more a part of their learning preference than watching and reflection. However it is also not surprising because the students do not have enough opportunity to reflect on their clinical experiences. They are more concerned about learning how to do it right than learning how what they do fits into the total treatment strategy for the patient. As instructors in the PT program, perhaps we are not allowing our students enough time to assimilate and reflect on what they have learned. When our students return from their clinical placements they should be given more opportunity to discuss and reflect on what they saw and what they learned in the clinical community. Fieldwork experiences should not be considered by students or faculty to be isolated from classroom experiences.

The combined scores of the practicing physical therapists revealed a similar trend to that of the students. Both practicing physical therapist groups were stronger in both the abstract-concrete dimension (thinking over feeling) and the action-reflection dimension (doing over watching). As a learning construct, doing something in class or clinical skills lab that you will need to do in clinical practice makes intuitive sense. The more one practices skills, the more one gains these skills, and feels more comfortable demonstrating those skills in a clinical setting. Hence "doing" is what physical therapists are trained and educated to do more of, but not exclusive from, the other learning modes. These other modes are not meant to be forgotten or under-utilized. One cannot generalize that practicing physical therapists do not use feeling and watching as part of their learning process. However when using the Kolb LSI to measure learning style preference, it does appear that the practicing physical therapists in this study preferred doing and thinking over watching and feeling.

Learning style preferences of physical therapy students

The results of this study indicate that the majority of the physical therapy students in the Physical Therapy program at the University of Alberta had similar learning style preferences, regardless of year in the program. The preferred learning styles identified using the Kolb LSI were Converger and Assimilator, and these results were consistent across the four years of the students in the PT program. When student learning style preferences were examined year by year, there were no significant differences found within or across years. This is consistent with other research on the learning styles of physical therapy students (Barb et al. 1997; Daniel, 1999; Farina, 1997; Katz & Heimann, 1991; Pisarski, 1994; Wessel et al. 1999). One learning style

(Converger) was more prevalent in the first, second and fourth year groups while the third year group were predominantly Assimilators.

These results suggest that learning style is not influenced by the education program nor years of experience within the program. It is more likely that persons with a particular learning style are more attracted to physical therapy, or are able to meet the academic requirements for entry (Wessel et al. 1999). The high grade point average (GPA) of physical therapy students enrolled in physical therapy programs indicates a selection bias in admission of these students (Farina, 1997). These students have demonstrated academic success by being accepted into highly competitive professional programs. The admitted students may have adjusted their learning style to reflect what is appropriate to match the teaching styles in professional and higher education.

Students applying to our physical therapy program come from two distinct groups: high school students (no university) and university transfer students (some university). Neither group had their learning style assessed as a part of the admission process to the physical therapy program, so their learning style was an unknown entity until the Kolb LSI was administered as part of a communication course in first year. Admission literature (Balogun, Karacoloff & Farina, 1986; Hunt et al. 1998; Saarinen & Salvatori, 1994) suggests that nonacademic criteria should also be evaluated for admission to professional programs, and that these criteria should reflect the roles and attributes required in the field. Admission to our physical therapy program requires very high academic grades because it is a limited enrolment program. Over 500 students apply annually, and from those, the top 140 to 150 are invited for an interview. It is possible that persons with a particular learning style perform better in the interview. Indeed, the interview used for admission is a behavioural interview, where applicants are presented with situations where they are asked questions such as "How would you deal with this situation?", or "Describe a time when you were working in a group." This type of interview is designed to draw upon the applicant's life experiences and how these experiences can be used in a variety of learning situations and to problem solve. Those applicants who can readily describe their life experiences within the context of the situation presented to them tend to do well in the interview. The characteristics in the interview coincide with the affective domain of physical therapy practice in Canada as identified by Aston-McCrimmon and Hamel (1983) and Loomis (1985a &1985b).

Physical therapy students learn by thinking, logically analyzing ideas and using a systematic plan to solve problems. They place less emphasis on personal involvement with people and on their feelings. Physical Therapy students who are Assimilators can understand and logically organize a wide range of information, but may not be concerned with the practical application of the information. Physical Therapy students who are Convergers will look for alternative ways of doing procedures or explaining specific patient procedures. These students are better at making decisions, but their thoughts may lack focus and they may solve the wrong problem (Wessel et al. 1999). Both these groups (Assimilators and Convergers) place their greatest strength in the practical application of ideas. In physical therapy, students and clinicians are encouraged to think “outside the box” and to be innovative in treatment planning and decision-making. While this caters to Assimilators and Convergers, it is not a strategy that necessarily works for all types of learners.

Kolb’s learning theory suggests that effective problem solving requires all four modes of learning (Kolb, 1984). Using this model, students who rely on abstract conceptualization will be strong in their ability to select a problem and consider solutions, but may not be able to execute the solution or recognize all the problems (Wessel et al. 1999). Pisarski (1994) expressed some concern about the literature that describes physical therapy students as primarily Assimilators rather than Accommodators. From a practical point of view, it makes sense that a physical therapist is a “hands-on” person. The very nature of physical therapy practice demands personal attention to patients, combining assessment and treatment skills in a very practical manner (Pisarski, 1994).

The students in this study were from all four years in the PT program. Each year presents the students with different challenges because the courses change from basic arts and science courses such as anatomy, psychology, and physiology, to more applied physical therapy professional courses. Often the instructors change as well once the professional courses commence being taught. These instructors tend to remain the primary instructors for the rest of the students’ program. In most of the professional physical therapy and rehabilitation courses, students are required to learn the requisite physical therapy skills in practical classes or clinical skills labs that accompany the theory component of a course. In these clinical skills labs, students are expected to try various physical therapy assessment and treatment skills repeatedly until they have mastered them, and can then reproduce them in a clinical skills lab examination. This is learning by doing, or active experimentation. We, as instructors, do not always take into consideration the learning styles and learning needs of the students — rather we expect them to learn by doing, because this is how our profession is practiced. Shepard and Jensen (1990) found that among a variety of physical therapy programs the way students are taught physical therapy skills aimed at competence is "strikingly similar" (p. 567). While this learning approach may not always be considered to be the "right" way, for the education of physical therapy students it does appear to be the most appropriate way. However, when it comes to students' preferred methods of learning, there may not be a substantive relationship between our teaching methods and their learning styles. So the question arises: do the students pick physical therapy education because they prefer to learn by active experimentation, and they expect to be taught that way, or do we as instructors teach that way because we feel it is the best way to learn physical therapy? Or does it really matter? There is some discussion among my academic and clinical colleagues that no matter how we teach it, the students will find a way to learn it.

Smith and Kolb (1986) describe five factors that can influence a person's learning style at any period in time. These factors are: personality, academic experience, career choice, current job, and current task. Several of these factors are applicable in the context of the current study. From the student perspective, career choice (physical therapy) and current task (being a student) may influence their learning style. The academic experience of these students is similar, yet different in that eighty percent of them had some university experience before entering the physical therapy program, while the other twenty percent entered the program directly from high school. However the academic experience within the physical therapy program would be the same for all students, as they take classes together. In other university courses such as English, there may be several sections of the same course, so students will have different professors and perhaps even different learning experiences. In the Physical Therapy courses at the University of Alberta, there are no course sections — all students are in class together and have the same professor. There may be laboratory sections, but even then the instructor usually remains the same. With similar academic experiences, student learning styles may likely be more similar. Farina (1997) went so far as to suggest that the students in her study had the same job (being students in a professional physical therapy education program), which may have influenced their learning styles.

Kolb (1985) suggests that different types of learners can improve their ability to use modes of learning. In the case of the physical therapy students in this study, the emphasis would be on developing accommodative and divergent learning skills to complement their converger and assimilative skills. Examples of what skills and strategies might be incorporated in teaching and learning are discussed later in this chapter.

Learning style preferences of practicing physical therapists

The learning style preference of the practicing physical therapists in the current study were similar to the physical therapy students. The majority of the practicing physical therapists were Convergers and Assimilators, and there were no differences between the two cohort groups. These data are unique compared to the only two other studies published using the Kolb LSI to determine the learning styles of physical therapists. Kolb (1984) referred to the unpublished work of Bennett, who in 1978 reported that physical therapy practitioners were mainly Accommodators. The difference from the present study may be in part explained by the fact that in 1978 practitioners may have received a relatively more practical education. Indeed, this researcher graduated from a three year diploma program that was designed for concrete learners. The physical therapy programs in Canada then were just changing from three year diploma programs to four year baccalaureate degrees, and the change in curricula reflected the move towards experiential learning through more diverse approaches than the traditional lecture-lab format (Alliance, 1993).

Katz and Heimann (1991) is the only relatively recent study that investigated the learning styles of practicing physical therapists. They found in Israel that in four of the professions (nursing, occupational therapy, physical therapy and social work) the practitioners strongly emphasized the active mode over the reflective. The physical therapists were Assimilators on the border of the Diverger type. They found that physical therapists were more concrete than their student counterparts. They suggest that people may become more concrete learners after they graduate.

The practicing physical therapists who volunteered for this study were found to be mostly Convergers, with Assimilators running a close second. Perhaps what contributes to the fact that the majority of the physical therapists in this study were Convergers and Assimilators is the fact they were all former physical therapy students at the University of Alberta. Whether these physical therapists were Convergers and Assimilators before they entered the PT program, or whether they were influenced by the nature of the skills required and the teaching methods used, remains an unanswered question. As well, physical therapy education has changed over the past 20 years, and even moreso over the past decade (Donaghy and Morss, 2000; Saarinen and Salvatori, 1994). Physical therapy educators are moving away from an approach which encourages reflecting on beliefs, values and attitudes to an approach that is linked more closely to systematic critical enquiry, problem solving and clinical reasoning (Donaghy and Morss, 2000). Experiential learning encourages a review of experience and identification of action to bring about a change in practice (Cross, 1993). This change in teaching methodology can influence the way students learn, which either works against or in favour of a preferred learning style.

The practicing physical therapists in the current study also shared several of the learning style factors described by Smith and Kolb (1986.) They all had the same job, the same career choice, and the same current task (treating patients). Indeed upon graduation they all shared the same academic training in a professional program. However as with the students, they had different academic backgrounds upon admission to the physical therapy program. It is still within the realm of possibility however, that these factors may have influenced their preferred learning style.

The results of the current study suggest "once a Converger, always a Converger". What is hypothesized here is that learning style preferences of physical therapy students should not be that different from the learning style preferences of practicing physical therapists. The preferred method of learning is unlikely to be influenced enough after graduation to change a learning style. The theory of physical therapy is taught during the undergraduate program, and the students are provided with the opportunity to put theory into practice during thirty one weeks of clinical placements (clinical fieldwork) throughout the PT program. During their clinical experience (1 five-week observation plus 6 five-week clinical placements), students have the opportunity to work with practicing physical therapists in order to learn and practice the appropriate knowledge, skills and attitudes. From this apprenticeship model, it is not surprising to find that preferred learning styles are the same between groups of physical therapy students and practicing physical therapists. What one prefers as a student relative to learning preference does not appear to change after graduation. The way recent graduates practice physical therapy does not appear to change from the way they learned physical therapy when they were students.

Learning style preferences over time

The learning styles of the student physical therapists and the practicing physical therapists in the current study did not change over time. This result is consistent with some authors (Kolb, 1984; Pinto & Geiger, 1991; Smith & Kolb, 1986) and inconsistent with others (Barb et al. 1997; Geiger & Pinto, 1991; Nulty & Barrett, 1996; Pinto, Geiger & Boyle, 1994). The uniqueness of the current study relative to physical therapy is that all the student groups (A-D) and one of the practicing physical therapists groups (E) had their learning style measured longitudinally in order to examine for change. One student group (D) and one group of practicing physical therapists (Group E) had a two and a half year gap between first and second measurements using the Kolb LSI. This time differential did not lead to significant changes in learning style preference. Kolb (1984) and Geiger and Pinto (1991) suggest that although learning style characteristics (AC, AE, CE, RO) may change over time, the combined scores (AC-CE and AE-RO) do not change substantively enough to demonstrate change in preferred learning style. Geiger and Pinto (1991), Nulty and Barrett (1996) and Pinto et al. (1994) suggest that learning styles can change and evolve over time and with experience. They suggest that the learning styles students adopt may be a result of a gradual process of adaptation to the learning demands placed on them and the reward systems which they experience. They also suggest that students can adapt, and go through a gradual induction into the culture of their chosen discipline.

In the current study, it was determined that more physical therapy students and physical therapists were Convergers or Assimilators than Accommodators or Divergers, and these learning styles did not change over time. There were shifts in learning style characteristics in that students and practicing physical therapists moved closer to or further away from the crosshairs on the Kolb LSI grid, but their overall learning style preference remained the same. Perhaps this can be attributed to the consistency of teaching methods employed by the teaching faculty and the consistency of teaching and learning opportunities for students in their clinical placements.

Learning style preference and gender

Gender had no influence on learning style preference in the current study. Both female and male physical therapy students and female and male practicing physical therapists were predominantly Convergers and Assimilators. These findings are consistent with previous studies using the Kolb LSI. Barb et al. (1997) found Assimilator was the predominant learning style at entrance and exit of a two year physical therapy program. They did find that the mean AE-RO combined score between males and females did change significantly from entrance to exit. The male students shifted toward the reflective orientation (a higher RO raw score on exit from entrance), and the female students shifted toward the active orientation (a higher AE raw score on exit from entrance). Pisarski (1994) found more Assimilators among male and female physical therapy students, with Convergers comprising the second largest group. Farina (1997) found both male and female physical therapy students from 3 countries

(Australia, Canada and the United States) were predominantly Convergers and Assimilators. She found the only significant difference between females and males was the raw AC (Abstract Conceptualization) score.

In the current study, gender differences were examined among the physical therapy students and practicing physical therapists in three areas: learning style characteristics, combined scores, and preferred learning style. Among the physical therapy students, the only significant differences found were that male students demonstrated a significantly higher mean AC (Abstract Conceptualization) score than female students. This suggests that the male students preferred thinking as opposed to feeling, a concern with building general theories as opposed to intuitively understanding unique, specific ideas, and a scientific as opposed to artistic approach to problems (Kolb, 1984).

With respect to the practicing physical therapists in the current study, the majority of both females and males preferred either the Converger or Assimilator learning style. There were differences in learning style preference between females and males, in that the percentages of female practicing therapists in each of the Accommodator, Assimilator and Convergers learning styles were significantly different than the males. This has not been previously described in the literature regarding physical therapists.

Teaching and learning

One reason for common learning styles could be similar teaching methods employed by physical therapy faculty (Farina, 1997). While many different teaching methods can be found among physical therapy faculty, Gaden (1992) found that the predominant teaching method in physical therapy education is the lecture. While this teaching method may be changing as current physical therapy curricula change, it was the predominant style for many years. Anderson and Adams (1992) found that the lecture as a teaching tool is very congruent with the Abstract Conceptualization learning mode and the Assimilator learning style. However these authors suggest that effective educators should be able to provide educational content in a manner which is congruent with a variety of learning styles. While keeping in mind the adage "you cannot be all things to all people", a good instructor can determine and utilize various strategies to facilitate learning among different learning styles. Svinicki and Dixon (1987) developed a series of instructional activities that support different aspects of the Kolb Learning Cycle. (See Figure 5.1 on p. 131)

Kaplan and Kies (1995) pose the question: "Which comes first, learning styles or teaching styles?" They suggest that while educators often view instruction and student learning as direct correlates, the relationship between teaching and learning does not directly correlate because learning is an internal process which can only take place when change of learner behaviour is observed. It does not naturally follow that if the teacher is working hard, students will learn. Kaplan and Kies (1995) offer four underlying assumptions about teaching and learning:

1. Teaching style and student learning styles can be identified.
2. Classroom teachers are most helpful when they assist students in

learning through their own style preferences.

3. Students should have the opportunity to learn through their preferred style.
4. Classroom teachers can develop a teaching style which is responsive to the wide variety of students in their classrooms. (p. 30)

In the current undergraduate physical therapy program at the University of Alberta there is a diversity of students with different educational backgrounds as well as cultural diversity. Entrance to our program is not on a "level academic playing field" because of the diversity of academic background. The range of academic achievement ranges from high school to some university to completed university degrees (baccalaureate, masters and doctorate). The Admissions Committee of the Department of Physical Therapy has attempted to level out the playing field in two ways. One method is by keeping the high school students and the university transfer students in their own selection groups (so that high school students are in competition only with other high school students). The other method is by having all eligible students go through a behavioural interview. The attempt here is to judge the students' ability to "think on their feet". This process has helped us with admissions for the past 15 years, however it has been suggested within the Department of Physical Therapy that perhaps another element should be added to the selection process. One suggestion has been to determine the students' learning style to see if they would be suited to our physical therapy program. However if one thinks about the need for diversity among students to enhance learning, do we really want all of our students to be the same? On the other hand, a recent meta-analysis of 42 experimental studies revealed that the overall academic achievement of students whose learning styles were taken into consideration could be expected to achieve 0.75 of a standard deviation higher than those who had not had this benefit (Dunn, Griggs, Olsen, Beasley & Gorman, 1995). This study suggested that matching students' learning style preferences with educational interventions compatible with those preferences would increase their academic achievement.

Kolb (1984) suggests as learners we need all four modes of learning, (abstract conceptualization, active experimentation, concrete experience, and reflective observation) and that the best learners are those whose learning styles are comprised of nearly equal parts of each type (Accommodator, Assimilator, Converger, Diverger). He believes that different types of learners can improve their ability to use modes of learning by developing the learning strategies to complement their current learning style. In the case of physical therapy students and practicing physical therapists in the current study, the emphasis would be on accommodative and divergent learning skills. This could involve more opportunities for the students to deal with people (earlier clinical contact or earlier patient interaction), and to consider people's feelings and values.

Wessel et al. (1999) suggest case histories or scenarios that involve ethical issues, cross-cultural values, and conflict of ideas could be used in problem-solving sessions or for group assignment. Indeed, a relatively new compulsory course in the PT program at the University of Alberta is INTER-D 410, a course for students in Nursing, Medicine, Dentistry, Pharmacy, and Rehabilitation Medicine. This is a process learning course intended to provide experience in team building a team of health care professionals from different disciplines, with emphasis on team building and recognizing the unique contributions from the different disciplines, the patients and their families. We have also used reflective diaries in our program to encourage students to think about what they have learned from an exercise and how this learning might be applied in the future. The diaries can also be used to help students recognize how they learn and whether they have fully utilized the learning cycle (Wessel et al. 1999). Within physical therapy education, this is not normally the way curricula are delivered to the students. Theoretical classes provide the framework around certain curriculum constructs — the students then learn to apply assessment and treatment principles in laboratory classes, in clinical skills labs, or in clinical practicum placements at a variety of treatment facilities. It is much more an experiential approach to learning than a reflective approach.

Raschick et al. (1998) suggested that different learning cycles and activities can be used to facilitate learning for students with different learning traits. One learning cycle might have inductive students initially participate in interviews (concrete experience), then be asked to reflect on the experience (reflective observation). They then formulate conclusions or generalizations on interviewing (abstract conceptualization), and finally they could try out their ideas of good interviewing skills (active experimentation). Deductive students, on the other hand, could begin with a conceptual discussion of the components of effective interviewing (abstract conceptualization), then proceed to creatively applying these principles to various case scenarios (active experimentation). Personally conducting client interviews would follow (concrete experience), and the students would finally reflect on these experiences (reflective observation).

Smith and Kolb (1986) presented a summary of the learning strengths and preferred learning situations discovered during their research, as seen in Table 5.1. What this table describes is not only how the people prefer to learn, but also how the teacher can use strategies to facilitate a preferred style of learning.

According to Dunn et al. (1995), matching students' learning styles with educational interventions compatible with those preferences would increase their academic achievement. Suggestions for teaching strategies as described by Svinicki and Dixon (1987) are found in Figure 5.1.

Table 5.1

Learning strengths and preferred learning situations for each of Kolb's learning style characteristics. (Adapted from Smith and Kolb, 1986, p. 28)

	LEARNING STRENGTHS	PREFERRED LEARNING SITUATIONS
Concrete Experience	• learning by *intuition* • learning from specific experiences • relating to people • sensitivity to people • sensitivity to feelings	• learning from new experiences • peer feedback and discussion • personalized counselling • teacher as coach/helper
Reflective Observation	• learning by *perception* • careful observation before making judgements • viewing things from different perspectives • introversion - looking inward for the meaning	• lectures • opportunities to take on observer role, to see different perspectives on an issue • objective tests of one's knowledge about an issue • teacher as guide/task master
Abstract Conceptualization	• learning by *thinking* • logical analysis of ideas • systematic planning • deductive thinking - acting on the basis of one's understanding of a situation	• theory readings • study time alone • clear, well-structured presentation of ideas • teacher as communicator of information
Active Experimentation	• learning by *doing* • ability to get things done • risk taking • extroversion - acting to influence people and events	• opportunities to practice and receive feedback • small group discussions • projects and individualized, self-paced, learning activities • teacher as role model on how to do it

CONCRETE EXPERIENCE
laboratories
observations
primary text reading
simulations/games
field work
trigger films
readings
problem sets
examples

ACTIVE EXPERIMENTATION
simulations
case study
laboratory
field work
projects
homework

REFLECTIVE OBSERVATION
logs
journals
discussion
brainstorming
thought questions
rhetorical questions

ABSTRACT CONCEPTUALIZATION
lecture
papers
model building
projects
analogies

Figure 5.1 Instructional activities that may support different aspects of the learning cycle. (Adapted from Svinicki & Dixon, 1987, p. 142)

Within the Department of Physical Therapy at the University of Alberta, most instructors utilize many of the activities described in Figure 5.1. However, they do not normally use these activities in the context of trying to make the students more "all-around" learners, or to try to involve them in all aspects of the learning cycle. These are simply the teaching and learning strategies that appear to work with physical therapy students. Many of the teaching faculty do not know what their students' learning styles are so they cannot assume to think they are enhancing or facilitating one learning style over another. Many of the strategies listed in Figure 5.1 are found in other professional programs because of the nature of the learning that is required. Lectures, seminars, laboratories, case studies, projects, homework, logs, journals, brainstorming, papers, projects and field work are all included in our Physical Therapy curriculum. These learning strategies come from all four learning cycle aspects and thus should contribute to all types of learners. As the results of the current research have shown, the majority of physical therapy students are Convergers and Assimilators, who both prefer to learn a theoretical construct and then reflect or experiment with it. If we, as instructors, knew our students' learning styles, we could most likely find the most appropriate strategies to facilitate their learning all the time, rather than the typical lecture-lab approach that is currently used for most courses. Instructors in our program, being primarily content experts, tend to focus their attention on the content of their course, equating "teaching" with "covering the content", and giving much less thought to the instructional methodology (Svinicki & Dixon, 1987). Certainly our students also learn from their field work placements which caters to the concrete experience and active experimentation components of the learning cycle. However, not all field work placements offer the same experiences to students, and some students feel more at ease watching and thinking before doing. Field work preceptors are also unaware of students' learning styles, thus they may be inadvertently stifling the most appropriate learning opportunities for the students.

In the past thirty years considerable interest has been focused on students' learning styles. Research has pointed out that students have distinct preferences for the way in which they receive and process information. Studies have also concluded that teachers need to be sensitive to the ways in which their students learn, and whenever possible, teach in ways that will enable students to succeed in using their learning preference. A lack of awareness of the uniqueness of individual learning styles may result in communication problems and learning blocks in the classroom (Kruzich et al. 1986). Student and instructor similarity in learning styles and educational strategies has been advocated to promote student motivation and achievement, which is evidence of effective learning (Olson, 2000). Students' preferences with certain teaching methods and instructional activities can be influenced by prior learning experiences, even if they are not ascribed to the students' learning style. Motivation to succeed and academic achievement may contribute to the student learning "outside" of his or her own preference in teaching methods and instructional activities (Olson, 2000). Therefore, although it is important to match the preferred learning styles in the professional curriculum to foster positive learning, students must be flexible and develop adaptive strategies outside their preferences in order to meet the needs of the challenging academic and clinical environments.

In addition to teaching methods, other factors that can influence and affect learning style are the dominant educational approach of the instructors, course work demands, the nature of the subject matter, and changes in the learning environment (from classroom to laboratory to clinical fieldwork). As instructors, if we increase the complexity and variety in our teaching approaches, and require more self-directed learning activities, students are encouraged to move from a role of dependence on the instructor for facts and direction, to a role where they begin to seek knowledge on their own, assume responsibility for analyzing potential solutions to problems, and justify the decisions they make. Students also modify and adjust what they need to do in order to reach their goal of the highest possible outcome. The results of the current study indicated that student learning style preference did not change over time, however the strategic learner does develop ways to adapt to changes in faculty teaching and to different clinical fieldwork placements.

Learning style inventory results, regardless of the instrument used, should not be a primary factor in decisions to alter curriculum approaches. However, the results of this study suggest that we should consider learning styles as one resource for adapting and sequencing our teaching methodologies. A learning styles inventory administered at the beginning of a physical therapy education program would provide faculty with the preferred learning styles of students in that class. This knowledge could prove helpful not only in planning teaching strategies, but also in developing approaches for remediating students experiencing difficulty in mastering the curriculum content. The more knowledge we have about our students, the greater the likelihood of success in reaching our ultimate goal of providing the best possible learning experience.

Conclusions

The discussion in this chapter supports the following conclusions:

1. Physical therapy students, regardless of year in the program, had similar learning styles which did not change over time.
2. Practicing physical therapists with two and three years of clinical experience, had similar learning styles which did not change over time.
3. There were no differences in the learning style preference among physical therapy students and practicing physical therapists.
4. The learning styles of the physical therapy students and practicing physical therapists in this study were not gender specific, although a greater percentage of males than females were Convergers in one of the practicing physical therapist groups.

Implications

The implications of the current study suggest that:

1. To facilitate learning, the preferred learning styles of physical therapy students should be determined, and instructors should employ teaching strategies that will facilitate those preferred learning styles.
2. Clinical supervisors (field work preceptors) should also be made aware of student learning styles so they can facilitate learning as efficiently and appropriately as possible in the clinical environment.
3. In order to understand learning style theory, instructors and clinical supervisors should have their preferred learning style determined.

Knowing one's own preferred learning style may make it easier to understand how to use teaching and learning strategies that facilitate learning for students with different learning styles.

4. In addition to understanding their own learning style, instructors and clinical supervisors should also be aware of their preferred teaching style. This will enable them to be able to identify which teaching strategies work best for which student learning style and in which teaching and learning situations (classroom versus clinical).
5. Because the results of this study revealed that the majority of PT students and practicing physical therapists were Assimilators and Convergers, the instructors in the program should teach to the strengths of these learning styles. As well, teaching to the affective domain and using a more student-centred teaching approach would address the needs of all students, as well as benefit the physical therapy profession.

Recommendations for further research

Based on the results of this study further research is warranted. Investigations should focus on the relationships between learning styles and the educational process. It is important to explore the relationships of learning styles of physical therapy students and practicing physical therapists and education, which fosters professional growth, and the knowledge, skills and attitudes essential in our ever-changing health care environment. The following are suggestions for future research:

1. Survey the academic teaching staff at the University of Alberta Physical Therapy program to determine their preferred learning styles.
2. Survey the academic teaching staff at the University of Alberta Physical Therapy program to determine their preferred teaching methods.
3. Compare the different teaching methods and strategies in the Physical Therapy program at the University of Alberta (traditional classroom instruction, clinical skills labs, seminars, problem solving, inquiry-based learning, evidence-based practice, clinical placements) and their relationship to students' preferred learning styles.
4. Explore the selection process used for admission to the physical therapy program at the University of Alberta and its relationship to the students' learning style preferences.

Personal reflections and final thoughts

This first started as a research project in 1995 with several colleagues (Wessel et al. 1999). The Department of Physical Therapy had developed a new curriculum and we wanted to modify our teaching strategies to involve more problem based or inquiry based learning. We were interested in knowing if students' problem solving ability was influenced by their preferred learning style. We knew that we had excellent students, but we did not know how good they were at problem solving. The original study was designed to determine the learning styles and problem-solving ability of undergraduate physical therapy students. One of the co-investigators convinced me that I should take this information further and use it for a PhD thesis. So I enrolled in the PhD program in Educational Administration and Leadership at the University of Alberta and embarked on what has become a six year journey.

When I first started planning what I wanted to investigate, I found there were only a handful of published studies on the learning styles of physical therapy students, and only one study on the learning styles of practicing physical therapists. Because we already had some learning styles data on some of our students, I decided to examine all four years of our students and to follow them for two years or more if possible while doing my PhD course work. By following them for two years I could look at the effects of time on learning style, and I could compare students to clinicians. Certainly there was no literature that compared the learning styles of a group of students before graduation and again two years after graduation. I also thought it would be interesting to find out the learning styles of another group of practicing physical therapists who had never had their learning style measured before. That would allow me to compare clinicians to clinicians, students to students, and clinicians to students.

When determining my research questions, I thought I would find several differences once the data were collected. Previous studies had determined that physical therapy students were mostly Convergers and Assimilators, and I felt no reason to think our students would be different. The one study that examined practicing physical therapists indicated they were mostly Assimilators. (This study was done in Israel and I am unaware of the type of physical therapy education they received.) I expected that practicing physical therapists in my study would be mostly experiential learners, as that is how we practice physical therapy. The fact they were primarily Convergers and Assimilators bore that out.

I fully expected to see changes in learning style over time. Although the majority of the literature does not support change over time, I was particularly interested in the transition from student to practitioner. My hypothesis was that because evaluation drives learning, the students would do what they needed to do to learn in school, but that once they became clinicians, evidence and problem-solving would drive their learning. I thought this would lead to a change in learning style, but it did not.

My final thoughts about this research have me wondering about the future. We, in the Department of Physical Therapy are changing from a baccalaureate program to an entry-level masters program commencing in September 2003. Our new students will have completed a baccalaureate degree in any field, and they will graduate after two and a half years with a Master of Physical Therapy (MPT) Degree. At the moment we are looking at admission and what the components of admission might be, including an interview and perhaps determining learning style. We want to graduate reflective practitioners who can think, analyze problems, and use evidence to facilitate their learning and their clinical practice. So the question is, do we feel that knowing an applicant's learning style will be beneficial to us as educators, and if so how? Do we want all of our students to be the same (as they mostly are now) or do we want all types of learners in order to foster the concept of diversity? Is what one learns more important than the way one learns, particularly in a professional program like Physical Therapy? If we want our new graduates to be reflective practitioners who are prepared to meet the challenges of client-centered, evidence-based practice, with appropriate knowledge, skills and professional attitudes, then we should accept any student who has met the academic and professional requirements, regardless of their preferred learning style. If we admit them, will they will learn any way? It is my belief that physical therapy students will learn how they need to learn, in order to do what they need to do, to become practicing physical therapists.

REFERENCES

Albanese, M.A., & Mitchell, S. (1993). Problem-based learning: A review of literature on its outcomes and implementation issues. Academic Medicine, 68, 52-81:

Alliance of Physiotherapy Regulatory Boards, Canadian Physiotherapy Association, & Council of Directors of Physiotherapy Education Programs (1993). Vision 1993: A vision for physiotherapy service delivery: recommendations of the planning task force. Toronto, Canada: Author

Anderson, J.A., & Adams, M. (1992). Acknowledging the learning styles of diverse student populations: implications for instructional design. New Directions for Teaching and Learning, 49, 19-33.

Angelo, T.A. (1994, June). From faculty development to academic development. AAHE Bulletin, 3-7.

Aston-McCrimmon, E., & Hamel, F. (1983). Physical therapy competencies: a market study. Physiotherapy Canada, 35 (2), 77-83.

Balogun, J.A., Karacoloff, L.A., Farina, N.T. (1986). Predictors of academic achievement in physical therapy. Physical Therapy, 66 (6), 976-980.

Barb, D.D., Scudds, R.A., & Scudds, R.J. (1997). A longitudinal study of learning styles within an MPT program (Abstract). Physical Therapy, 77, (Suppl. 5), 10.

Baron, H. (1996). Strength and limitations of ipsative measurement. Journal of Occupational and Organizational Psychology, 69 (1), 49-56.

Barris, R., Kielhofer, G., & Bauer D. (1985, February). Learning preferences, values and student satisfaction. Journal of Allied Health, 14, 13-23.

Barrows, H.S. (1985). How to design a problem-based curriculum for the preclinical years. New York: Springer Publishing Company.

Barrows, H.S., & Tamblyn, R.M. (1980). Problem-based learning: An approach to medical education. New York: Springer Publishing Company.

Baxter Magolda, M.B. (1989). Gender differences in cognitive development: An analysis of cognitive complexity and learning styles. Journal of College Student Development, 30, 213-220.

Boud, D., & Feletti, G. (1991). The Challenge of Problem Based Learning. London: Kogan Page Limited.

Butler, K.A. (1988, November/December). Learning88, 16, 30-34.

Canadian Physiotherapy Association (June, 2001). 2000 Member Value Perception Survey. Toronto, Canada: Author.

Cavanagh, S.J., Hogan, K., & Ramgopal, T. (1995). The assessment of student nurse learning styles using the Kolb Learning Style Inventory. Nurse Education Today, 15, 177-183.

Celli Sarasin, L. (1998). Learning Style Perspectives: impact in the classroom. Madison, WI: Atwood Publishing.

Cevero, R.M. (1992). Professional practice, learning, and continuing education: an integrated perspective. Int. J. of lifelong education, 11 (2), 91-101.

Claxton, C. S., & Murrell, P. H. (1987). Learning Styles: Implications for Improving Education Practices. ASHE-ERIC Higher Education Report No. 4. Washington: Association for the Study of Higher Education.

Cleather, J. (1995). Head, Heart and Hands: The story of Physiotherapy in Canada. Toronto: Canadian Physiotherapy Association.

Coker, C.A. (1996). Accommodating students' learning styles in Physical Education. JOPERD 67 (9), 66-68.

College of Physical Therapists of Alberta (2000). 1999-2000 Annual Report. Edmonton, Canada: Author

Cornwell, J.M., & Manfredo, P.A. (1994). Kolb's learning style theory revisited. Educational and Psychological Measurement, 54 (2), 317-327.

Council of Directors of Physical Therapy Academic Programs, & Canadian Physiotherapy Association [CDPAP/CPA] (1995, June). Entry-level curriculum for Canadian Physical Therapy Programs: Guidelines for Faculty. Toronto, Canada: Author.

Cross, K.P. (1990, December). Teachers as scholars. AAHE Bulletin, 3-5.

Cross, V. (1993). Introducing physiotherapy students to the idea of reflective practice. Medical Teacher, 15 (4), 293-307.

Daniel, J.A. (1999). Effects of learning style and learning environment on achievement of physical therapy graduate students in distance education. Unpublished doctoral dissertation, Texas Tech University, Lubbock, Texas.

Della-Dora, D., & Blanchard, L. (1979), as cited in Kruzich, J.M., Friesen, B.J., & Van Soest, D. (1986). Assessment of student and faculty learning styles: research and application. J. of Social Work Education, 22 (3), 22-30.

Department of Physical Therapy (1996, November). Revised curriculum document. University of Alberta, Edmonton, Canada: Author.

Department of Physical Therapy (2001, June). Admissions Committee Report. University of Alberta, Edmonton, Canada: Author.

Donaghy, M.E., & Morss, K. (2000). Guided reflection: A framework to facilitate and assess reflective practice within the discipline of physiotherapy. Physiotherapy Theory and Practice, 16, 3-14.

Dunn, R., Griggs, S., Olsen, J., Beasley, M., & Gorman, B. (1995). A meta-analytic validation of the Dunn and Dunn model of learning style preferences. Journal of Educational Research, 88, 353-362.

Farina, N.T.G. (1997). An analysis of the proposed influence of multiple factors on the learning characteristics of physical therapy students in three countries. Unpublished doctoral dissertation, The George Washington University, Washington, D.C.

Feletti, G. (1993). Inquiry based and problem based learning: How similar are these approaches to nursing and medical education? Higher Education Research and Development, 12 (2), 143-156.

Ferrell, B. G. (1983). A factor analytic comparison of four learning-styles instruments. Journal of Educational Psychology, 75 (1), 33-39.

Ferrier, B.M. (1990). Problem-based learning: Does it make a difference? J. Dent. Educ. 54, 550-551.

French, S. (1989). Teaching Methods: 3. Student centred learning. Physiotherapy, 75 (11), 678-680.

French, S., Neville, S., & Laing, J. (1994). Teaching and Learning: A guide for therapists. Oxford: Butterworth-Heinemann Ltd.

Gaden, K.R.P. (1993). Inclusion of Gregorc's Mind Styles Concepts in physical therapy curriculum and instruction in selected baccalaureate and post-baccalaureate programs (Doctoral dissertation, Andrews University, 1992). Dissertation Abstracts International, 53 (08), 2663-A.

Garity, J. (1985). Learning styles: Basis for creative teaching and learning. Nurse Educator, 10 (2), 12-16.

Geiger, M.A., & Boyle, E.J. (1993). An examination of ipsative and normative versions of Kolb's revised Learning Style Inventory. Educational and Psychological Measurement, 53 (3), 717-726.

Geiger, M.A., & Pinto, J.K. (1991). Changes in learning style preference during a three-year longitudinal study. Psychological Reports, 69, 755-762.

Graham, C.L. (1996). Conceptual learning resources in Physical Therapy students. Physical Therapy, 76 (8), 856-865.

Gregorc, A.F. (1982). An Adult's guide to style. Maryland, MA: Gabriel Systems Inc.

Griffiths, P. (1987). Creating a learning environment. Physiotherapy, 73 (7), 335-336.

Harb, J.N., Durrant, S.O., & Terry, R.E. (1993, April). Use of the Kolb learning cycle and the 4MAT system in Engineering education. Journal of Engineering Education, 82, 70-77.

Hick-Rheault, W. L. (1990). Learning styles of physical therapy students (Doctoral dissertation, University of Chicago, 1989). Dissertation Abstracts International, 50 (11), 3463-A.

Hicks, L.E. (1970). Some properties of ipsative, normative, and forced-choice normative measures. Psychological Bulletin, 74 (3), 167-184.

Higgs, J. & Boud, D. (1991). Self-directed learning as part of the mainstream of physiotherapy education. Australian Journal of Physiotherapy, 37 (4), 245-251.

Hunt, A., Adamson, B., Higgs, J., & Harris, L. (1998). University education and the physiotherapy professional. Physiotherapy, 84 (6), 269-273.

Jobling, M.H. (1987). Cognitive styles: some implications for teaching and learning. Physiotherapy, 73 (7), 335-338.

Kaplan, E. J., & Kies, D.A. (1995). Teaching styles and learning styles: which came first? Journal of Instructional Psychology, 22 (1), 29-33.

Katz, N. (1986). Construct validity of Kolb's learning style inventory using factor analysis and Guttman's Smallest Space Analysis. Perceptual and Motor Skills, 63, 1323-1326.

Katz, N. (1990). Problem solving and time: functions of learning style and teaching methods. The Occupational Therapy Journal of Research, 10 (4), 221-236.

Katz, N., & Heimann, N. (1991). Learning style of students and practitioners in five health professions. The Occupational Therapy Journal of Research, 11 (4), 238-244.

Keefe, J.W. (1982). Assessing student learning styles: an overview. Selected papers from the National Conference sponsored by the Learning Styles Network. Student learning styles and brain behavior. (pp. 43-54). Reston, Virginia: Author.

Kember, D., & Gow, L. (1994). Orientations to teaching and their effect on the quality of student learning. J. of Higher Education, 65 (1), 58-74.

Knapper, C.K. (1995). Understanding student learning: Implications for practice. In W.A. Wright & Associates (Eds.), Teaching improvement practices (pp. 58-75). Bolton, MA: Anker.

Kolb, D.A. (1976). Learning Style Inventory: Technical manual. Boston, MA: McBer & Co.

Kolb, D.A. (1984). Experiential learning. Englewood Cliffs, NJ: Prentice-Hall.

Kolb, D.A. (1985). Learning Style Inventory: Self-scoring inventory and interpretation booklet. Boston, MA: McBer & Co.

Kruzich, J.M., Friesen, B.J., & Van Soest, D. (1986). Assessment of student and faculty learning styles: research and application. J. of Social Work Education, 22 (3), 22-30.

Loo, R. (1999). Confirmatory factor analyses of Kolb's Learning Style Inventory (LSI-1985). British Journal of Educational Psychology, 69, 213-219.

Loomis, J. (1985a) Evaluating clinical competence of physical therapy students: the development of an instrument, Part 1. Physiotherapy Canada, 37 (2), 83-89.

Loomis, J. (1985b) Evaluating clinical competence of physical therapy students: assessing the reliability, validity and usability of a new instrument, Part 2. Physiotherapy Canada, 37 (2), 91-98.

Marshall, J.C., & Merritt, S.L. (1986). Reliability and validity of the learning style questionnaire. Educational and Psychological Measurement, 46 (1), 257-262.

Messick, S. (1976). Personality consistencies in cognition and creativity. In Messick, S. & Associates: Individuality in learning. San Francisco: Jossey-Bass Publishers.

Meyer, J.H.F., Dunne, T.T., & Richardson, J.T.E. (1994). A gender comparison of contextualized study behaviour in higher education. Higher Education, 27, 469-485.

Morris, J. (1993). An overview of and comparison among three current approaches to medical and physiotherapy undergraduate education. Physiotherapy, 79 (2), 91-94.

Neville, S., & French, S. (1991). Clinical education: students' and clinical tutors' views. Physiotherapy, 77 (5), 351-354.

Norman, G.R. (1988). Problem-solving skills, solving problems and problem-based learning. Med. Educ. 22, 279-286.

Nulty, D.D., & Barrett, M.A. (1996). Transitions in students' learning styles. Studies in Higher Education, 21 (3), 333-345.

Olson, V.G. (2000). Physical therapy student learning styles and their preference for teaching methods and instructional activities. Unpublished doctoral dissertation, Seton Hall University, and the University of Medicine and Dentistry of New Jersey.

Payton, O.D., Hueter, A.E., & McDonald, M.E. (1979). Learning style preferences. Physical Therapy, 59 (2), 147-152.

Pickworth, G.E., & Schoeman, W.J. (2000). The psychometric properties of the Learning Style Inventory and the Learning Style Questionnaire: Two normative measures of learning styles. South African Journal of Psychology, 30 (2), 44-52.

Pinto, J.K., & Geiger, M.A. (1991). Changes in learning-style preferences: a prefatory report on longitudinal findings. Psychological Reports, 68, 195-201.

Pinto, J.K., Geiger, M.A., & Boyle, E.J. (1994). A three-year longitudinal study of changes in student learning styles. Journal of College Student Development, 35, 113-119.

Pisarski, E.M. (1994). A comparison of postbaccalaureate entry-level physical therapy students' learning styles and perceptions of the higher educational environment. Unpublished doctoral dissertation, Columbia University Teachers College, New York, N.Y.

Portney, L.G., & Watkins, M.P. (2000). Foundations of Clinical Research, 2nd ed. Norwalk, Connecticut: Appleton & Lange.

Rahr, R.R. (1988). Basic learning styles and the relationships to achievement in allied health and nursing (Doctoral dissertation, University of Houston, 1987). Dissertation Abstracts International, 49 (4), 940-A.

Rakoczy, M., & Money, S. (1995). Learning styles of nursing students: A 3-year cohort longitudinal study. J. of Professional Nursing, 11 (3), 170-174.

Raschick, M., Maypole, D.E., & Day, P.A. (1998). Improving field education through Kolb learning theory. Journal of Social Work Education, 34 (1), 31-41.

Richardson, J.T.E., & King, E. (1991). Gender differences in the experience of higher education: quantitative and qualitative approaches. Educational Psychology,11 (3/4), 363-382.

Richter, R. (1992). A critical evaluation of cognitive style assessment: A report presented to the Human Science Research Council. Pretoria, South Africa. (ERIC Document Reproduction Services No. ED 355 016).

Rouse, M.W. (1990). Problem-based learning: An alternative to traditional education. J. Of Optometric Education, 15 (4), 111-112.

Ruble, T.L., & Stout, D.E. (1990). Reliability, construct validity, and response-set bias of the revised learning-style inventory (LSI-1985). Educational and Psychological Measurement, 50 (3), 619-630.

Rudestam, K.E., & Newton, R.R. (1992). Surviving your dissertation: a comprehensive guide to content and process. Newbury Park, Calif.: Sage.

Saarinen, H. & Salvatori, P. (1994). Educating occupational and physiotherapists for the year 2000: what, no anatomy course? Physiotherapy Canada, 46 (2), 81-86.

Sandmire, D.A., Vroman, K.G., & Sanders, R. (2000). The influence of learning styles on collaborative performances of allied health students in a clinical experience. Journal of allied Health, 29 (3), 143-149.

Severiens, S.E., & Ten Dam, G.T.M. (1994). Gender differences in learning styles: A narrative review and quantitative meta-analysis. Higher Education, 27, 487-501.

Sharp, J.E., Harb, J.N., & Terry, R.E. (1997, April). Combining Kolb learning styles and writing to learn in Engineering classes. Journal of Engineering Education, 93-101.

Shepard, K.F., & Jensen, G.M. (1990). Physical therapist curricula for the 1990s: educating the reflective practitioner. Physical Therapy, 70 (9), 566-577.

Sims, R.R., & Sims, S.J. (1995). The Importance of Learning Styles. Westport, Connecticut: Greenwood Press.

Sims, R.R., Veres, J.G. III, Watson, P., & Buckner, K.E. (1986). The reliability and classification stability of the Learning Style Inventory. Educational and Psychological Measurement, 46, 753-760.

Smith, D.M., & Kolb, D.A. (1986). User's guide for the learning style inventory: A manual for teachers and trainers. Boston: McBer.

Smith, R.A. (1995). Reflecting critically on our efforts to improve teaching and learning. To improve the academy, 14, 5-25.

Smith, R.M. (1982). Learning how to learn. Chicago: Follett Publishing.

Solomon, P. (1994). Problem-based learning: A direction for physical therapy education? Physiotherapy Theory and Practice, 10, 45-52.

Stafford, E.M. (1986). Relationship between occupational therapy student learning styles and clinical performance. American Journal of Occupational Therapy, 40, 34-39.

Stice, J.E. (1987, February). Using Kolb's Learning Cycle to improve student learning. Engineering Education, 291-296.

Svinicki, M.D., & Dixon, N.M. (1987). The Kolb model modified for classroom activities. College Teaching, 35 (4), 141-146.

Titchen, A.C. & Coles, C.R. (1991). Comparative study of physiotherapy students' approaches to their study in subject-centred and problem-based curricula. Physiotherapy Theory and Practice, 7, 127-133.

Tolnai, S. (1991). Continuing medical education and career choice among graduates of problem-based and traditional curricula. Medical Education, 25, 414-420.

Van Langenberghe, H.V.K. (1988). Evaluation of students' approaches to studying in a problem-based physical therapy curriculum. Physical Therapy, 68(4), 522-526.

Vayda, E., & Bogo, M. (1991). A teaching model to unite classroom and field. J. of Social Work Education, 27 (3), 271-278.

Veres, J.G. III, Sims, R.R., & Locklear, T.S. (1991). Improving the reliability of Kolb's revised Learning Style Inventory. Educational and Psychological Measurement, 51, 143-150.

Vernon, D.T.A., & Blake, R.L. (1993). Does problem-based learning work? A meta-analysis of evaluative research. Academic Medicine 68, 550-563.

Vernon-Gerstenfeld, S. (1989). Serendipity? Are there gender differences in the adoption of computers. A case study. Sex Roles: A Journal of Research 21 (3-4), 161-173.

Vittetoe, M.C. (1983). A study of learning style preferences of medical technology and physical therapy students. American Journal of Medical Technology, 49 (9), 661-664.

Walton, H.J., & Matthews, M.B. (1989). Essentials of problem-based learning. Journal of Medical Education, 23, 542-558.

Weber, M.D., Olson, J., Barker, J., Perry, M., & Burgess, R.M. (1996). Learning styles of physical therapy students and early academic achievement in physical therapy school. Physical Therapy, 76, (Suppl. 5), 13.

Weinstein, C.E. (1988). Assessment and Training of Student Learning Strategies. In R.A. Schmeck (Ed.), Learning Strategies and Learning Styles (pp. 291-316). New York: Plenum Press.

Wessel, J., Loomis, J., Rennie, S., Brook, P., Hoddinott, J., & Aherne, M. (1999). Learning styles and perceived problem solving ability of students in a baccalaureate physiotherapy program. Physiotherapy Theory and Practice, 15, 17-24.

Willcoxson, L. & Prosser, M. (1996). Kolb's Learning Style Inventory(1985): review and further study of validity and reliability. British Journal of Educational Psychology, 66, 247-257.

APPENDIX A

Consent Form

Groups A, B, C & D (Physical Therapy students in years 1-4)

CONSENT FORM

You are invited to participate in a study about learning styles of physical therapy students and practicing physical therapists. The purposes of this study are to: (1) examine physical therapy student learning styles over time and examine if any change occurs from one year to the next or within one academic year, and (2) to examine the learning styles of practicing physical therapists and compare them to the learning styles of physical therapy students. This information is important to the physical therapy curriculum and to the practice of physical therapy for new graduates.

As part of this study, you will be asked to complete two questionnaires. At the beginning of term one there will be a questionnaire about your learning style. This questionnaire will be administered again at the end of second term. You will be asked to include your student ID number on study questionnaires but they will be coded by the investigator for research purposes. Your responses will be known only to the investigator.
Your marks in any courses taken during the academic year will not be affected by participating in the study.

I, ______________________________ agree to participate in the study on learning styles of undergraduate physical therapy students based on the information provided above. The study and my participation has been explained. I understand what is required of me. I understand that all information will be confidential. Publications arising from this study will describe general results and my name will not appear in print. I realize that I may contact the investigator with questions at any time during the study. I can withdraw from the study at any time. I have received a copy of this consent form.

____

Signature   date

____

Investigator   date

Sandy Rennie, Graduate Student/Investigator
Department of Educational Policy Studies
c/o Room 2-50, Corbett Hall (Ph. 492-5973)

Graduate Supervisor: Dr. David Collett
Department of Educational Policy Studies
Room 7-104 Education North (Ph. 492-5621)

APPENDIX B

Consent Form

Groups E and F (Practicing physical therapists)

CONSENT FORM

You are invited to participate in a study about learning styles of physical therapy students and practicing physical therapists. The purposes of this study are to: (1) examine physical therapy student learning styles over time and examine if any change occurs from one year to the next or within one academic year, and (2) to examine the learning styles of practicing physical therapists and compare them to the learning styles of physical therapy students. This information is important to the physical therapy curriculum and to the practice of physical therapy for new graduates.

As part of this study, you will be asked to complete a questionnaire. This questionnaire is designed to determine your preferred method of learning. The tool used is the Kolb Learning Style Inventory. You will be asked to include your student ID number on the questionnaire but it will be coded by the investigator for research purposes. If you do not remember your student ID number, please use your birthdate (dd/mm/yy). Your responses will be kept completely confidential.

I, ____(please print name) agree to participate in a study on learning styles of physical therapy students and practicing physical therapists based on the information provided above. The study and my participation has been explained. I understand what is required of me. I understand that all information will be confidential. Publications arising from this study will describe general results and my name will not appear in print. I realize that I may contact the investigator with questions at any time during the study. I can refuse to participate or withdraw from the study at any time without consequence. I have received a copy of this consent form.

____

Signature date

____

Investigator date

Sandy Rennie, Graduate Student
Department of Educational Policy Studies
c/o Room 2-50, Corbett Hall (Ph. 492-5973)

Graduate Supervisor: Dr. David Collett
Department of Educational Policy Studies
Room 7-104 Education North (Ph. 492-5621)

APPENDIX C

Department of Educational Policy Studies

Ethics Committee Approval

DEPARTMENT OF EDUCATIONAL POLICY STUDIES

Research Ethics Review Application - Graduate Student Form

Name G.A. (Sandy) Rennie Student I.D. 674282

Short Title of Study Learning Styles of Undergraduate Physical Therapy Students

____ M.Ed. Project X Ph.D. Thesis ____ Ed.D. Thesis

____ M.Ed. Thesis ____ Other ____________ (Specify)

Members of the Supervisory Committee: Dr. Dave Collett; Dr. Paula Brook; Dr. Mike Andrews; Dr. Jean Wessel

The applicant agrees to notify the Department Research Ethics Committee of any changes in research design after the application has been approved.

________________ (Signature of Applicant) October 16 1997 (Date)

The supervisor of the study approves submission of this application to the Research Ethics Review Committee.

________________ (Signature of Supervisor) Oct 16/97 19__ (Date)

For Office Use Only

Date Submitted Oct. 16/97 Date Decision Conveyed ____________

Members of the Review Committee ~~Dr~~ Prof. A. Deane, Dr. F. Peters, Dr. C. Montgomerie, Dr. B. Magnes

Decision of Committee ~~Not approved~~ Approved (Approved/not approved) October 29, 1997 November 13, 1997 (Date)

Comments: Ethical issues with respect to the "instructors/professors" whose teaching methods are central to this research need further consideration by the researcher.

AK Deane (Coordinator's Signature)

Nov 13, 1997 The researcher has provided excellent supporting documentation and has clarified the issues that were raised. AK Deane

APPENDIX D

Letter to physical therapy students out on clinical placements

UNIVERSITY OF ALBERTA

March 18, 1998

Dear Future Colleague:

As you know I am currently in the data collection component of my PhD program in Education here at the University of Alberta. My research project is about learning styles - that is, how we **prefer** to learn. I am using a tool called the Kolb Learning Style Inventory (LSI) to gather data from students and physical therapists about how they prefer to learn. My research questions are: (1) will the learning styles of Physical Therapy students change over time while in the P.T. program, and (2) are the learning styles of practicing physical therapists different from P.T. students.

In order to examine if your learning style has changed I need to collect one more set of data from you, and I would be most pleased if you would help me in this regard. I have your Kolb scores from previous collection points and I would like to compare them to your Kolb LSI scores now. Enclosed are the following:

1. A Kolb LSI form to be completed. Please read the top instructions carefully. The way you like to learn the **most** is a **4** and the way you like to learn the **least** is a **1**. Use all four numbers (1-4) for each question. Please identify yourself by your U of A ID number only.
2. A return, self-addressed envelope for you to use once you have completed the Kolb LSI.

Previously, you signed a consent form to participate in this study. Should you not wish to continue, please return the uncompleted Kolb LSI form in the enclosed envelope.

I realize that everyone is very busy these days and that completing questionnaires often goes to the bottom of the priority list! However this particular questionnaire takes only about 10 to 15 minutes to complete and it is not difficult. Your willingness to participate in this research project is very much appreciated. If you have any concerns or questions, please do not hesitate to contact me. Thank you in advance for your cooperation and assistance.

Please return the completed forms to me by Monday, April 13, 1998. Thank you.

Sincerely yours,

Sandy Rennie
Associate Professor and Graduate Student
email: Sandy.Rennie@ualberta.ca
Ph (403) 492-5973 FAX (403) 492-1626

Department of Physical Therapy
Faculty of Rehabilitation Medicine

2-50 Corbett Hall • University of Alberta • Edmonton • Canada • T6G 2G4
Telephone: (780) 492-5983 • Fax: (780) 492-1626
www.ualberta.ca

APPENDIX E

Letter to practicing physical therapists

UNIVERSITY OF ALBERTA

February 20, 1998

Dear Colleague:

I am currently in the data collection component of my PhD program in Education here at the University of Alberta. My research project is about learning styles - that is, how we prefer to learn. I am using a tool called the Kolb Learning Style Inventory (LSI) to gather data from our students about how they prefer to learn. I would also like to gather data from practicing therapists about how they prefer to learn. My research questions are: (1) will the learning styles of Physical Therapy students change over time while in the P.T. program, and (2) are the learning styles of practicing physical therapists different from P.T. students.

In order to examine and compare the learning styles of the two groups, I need to collect some data, and I would be most pleased if you would help me in this regard. Enclosed are the following:

1. A Kolb LSI form to be completed. Please read the top instructions carefully. The way you like to learn the **most** is a **4** and the way you like to learn the **least** is a **1**. Use all four numbers (1-4) for each question. Please identify yourself by your U of A ID number only. If you cannot remember it, please use your birthdate (dd/mm/yy).
2. Two consent forms, both signed by me. If you are willing to participate, please sign and date one and return it with the completed Kolb LSI.
3. A return, self-addressed envelope for you to use once you have completed the Kolb LSI and signed and dated the consent form.

I realize that everyone is very busy these days and that completing questionnaires often goes to the bottom of the priority list! However this particular questionnaire takes only about 10 to 15 minutes to complete and it is not difficult. Your willingness to participate in this research project is very much appreciated. If you have any concerns or questions, please do not hesitate to contact me. Thank you in advance for your cooperation and assistance.

Please return the completed forms to me by, Friday, March 13, 1998. Thank you.

Sincerely yours,

Sandy Rennie
Associate Professor and Graduate Student
email: Sandy.Rennie@ualberta.ca
Ph (403) 492-5973 FAX (403) 492-1626

Department of Physical Therapy
Faculty of Rehabilitation Medicine

2-50 Corbett Hall • University of Alberta • Edmonton • Canada • T6G 2G4
Telephone: (780) 492-5983 • Fax: (780) 492-1626
www.ualberta.ca